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CONTENTS.

Editorial 287
Report of New York Gas and Electricity Commission..... 290
New York, Cuba and Colon Cable..... 290
Helion Lamp 290
Electrical Apparatus in the Philippines..... 291
New Telephone Exchange for Worcester, Mass..... 291
Problems in Electrochemistry 291
Strength of Insulator Pins..... 292
Commercial Relation of Sunlight and Electric Light..... 292
Alternating-Current Machine with Shunt Motor Characteristics.... 293
Flexible Transformer Construction 293
Incandescent Film Lamp 294
Current News and Notes..... 294
Electrical Equipment of the West Virginia Pulp and Paper Company, Piedmont, W. Va. 297
Graphical Diagram for Determining the Reactance in Alternating Current Circuits. By T. W. Varley..... 301
Three-Phase Transformation. By A. S. McAllister..... 302
English Electrical Law in 1906. By A. Britton..... 304
Generating Station of the Mount Union Light & Power Company, of Mount Union, Pa. 305
Prevention of Sparking in Alternating-Current Commutator Motors. 306
Recent Electrochemical Developments..... 306
New Telephone Patents 307
LETTERS TO THE EDITORS:
Use of Commercial Hot Wire Instruments for Very Small High Frequency Currents. By L. W. Austin.... 308
Estimation of Armature Diameter. By J. L. Heinrich..... 308
Railroad Motor with Commutating Poles. By W. H. Warren..... 308
A Note on Carborundum. By H. J. Round..... 309
Digest of Current Electrical Literature..... 309
Book Review 313
The Edison Club of Schenectady, N. Y. By F. M. Feiker..... 314
Tests of Flexible Cord..... 315
Motors for Operating Beer Pumps..... 316
Variable-Speed Direct-Current Motors 316
Jaeger Direct-Connected Gasoline Engine..... 317
Hand-Driven Carborundum Grinder 317
Industrial and Commercial News..... 318
General News 320
Weekly Record of Electrical Patents..... 327

THREE-PHASE TRANSFORMATION.

The relative merits of three-phase transformers versus groups of three single-phase transformers, in the transmission and distribution of power, form a large question that is capable of being discussed from various standpoints, such as those of the manufacturer, the constructing engineer, the operating engineer, or the purchaser. There is a considerable difference of opinion on the subject, partly attributable to the difference of standpoint of the various parties that have taken up the discussion. In Europe the three-phase transformer has been more popular than in this country, at least until recently. A popular argument in favor of the three-phase transformer has been the greater compactness of the transformer unit. A favorite argument against the three-phase transformer has been that if a three-phase transformer becomes disabled in service all three sides of the system must be made to suffer by disconnecting the apparatus for repair; whereas if a similar accident occurs to any one of three single-phase transformers in a delta group, the removal of the defective transformer only affects one side of the system, and two-thirds of the unit would go on working.

The article by Dr. A. S. McAllister, appearing on page 302 of this week's number, deals with the matter from several standpoints. It indicates that a three-phase transformer is less heavy, less costly and less power wasting than a group of three single-phase transformers of equal aggregated power; but is in corresponding measure inferior to one single-phase transformer, or the equivalent transforming apparatus if the system were changed from three-phase to single-phase. Here is a blissful new weapon and argument all ready for being brandished by those engineers who seek to introduce single-phase railway systems, as opposed to three-phase systems. Until very recently we all believed, as a cardinal element of doctrine, that the three-phase system was more economical and efficient than the single-phase system, both in line conductors and in generator proportions. Some electrical men are reported to have recited this creed every morning before commencing the day's work. That was in the days when there was no large single-phase motor available. Now we are told unblushingly by some that the saving in copper for line conductors, alleged for the three-phase system, was a fond idea vainly invented, and that the alleged superiority of the three-phase generator over the single-phase generator is fictitious and insignificant.

The article, moreover, points out that although a pair of open delta-connected transformers, joined to two sides of a three-phase system, are commonly used for operating small three-phase motors in order to save the expense of a third transformer and a complete delta group; yet better results are generally capable of being obtained by tee-connecting the same two transformers. Strictly speaking, this means bringing a middle tap out from the primary of one of the two transformers, and also reducing the turns and voltage of the other transformer by 13.4 per cent. Even, however, with two full-voltage transformers, improvement is claimed for the tee over the open delta connection.

The article furnishes a convenient approximate rule for determining the weight of and also the power waste in a transformer for any given rated output. This rule may be expressed in various ways, but one is that the weight and waste increase as the 0.75 or ¾ power of the rated output, to a first approximation, with the understanding that no rigid rule can be expected to apply to a large number of different types and makes of transformer through a wide range of sizes. For example, if we take the average weight of a 1-kw transformer as, say, 80 lb.; then the weight of a 16-kw transformer would be roughly $16^{3/4} \times 80$, or 640 lb. The article also points out that since the full-load current density in the copper windings of transformers tends to approach the same value, and that the working magnetic density in the iron cores also tends to approach a like value in all sizes of core, the waste of power at a given percentage of load tends to follow the weight of transformers; so that, to a first approximation, in transformers of equally good manufacture, the total waste is as the weight. Of course, if the flux density or current density in transformers were forced upwards in the larger sizes, this proposition could not hold.

The Standardization of Incandescent Lamps in Great Britain.

Announcement has recently been made that the British Engineering Standards Committee has issued standardization specifications for carbon filament incandescent lamps. The standards specify both 8-h.cp lamps and 16-h.cp lamps. Both 8's and 16's are divided into 110-volt and 220-volt varieties. The standard 800-hour, 110-volt, 16-cp lamp has a specific consumption of 3½ watts per candle, while the standard 800-hour, 110-volt, 8-cp lamp has a specific consumption of 3¾ watts per candle. It must be remembered that the candle-power referred to in the British specifications is in terms of the Vernon-Harcourt 10-cp pentane lamp, and, according to the determinations of the Reichsanstalt, is 1.1 hefner; whereas the old British candle prior to the Vernon-Harcourt used to be brighter, or 1.14 hefner. The French Testing Laboratories have even recently published results which show that the new British standard candle is down to 1.07 hefner. In this country the old British standard candle-power is retained, which is thus, perhaps, 5 per cent brighter than the standard candle-power of the new British specifications. The new standard British 220-volt lamps are allowed about 20 per cent more consumption than the lamps of corresponding candle-power for 110 volts. The mean horizontal candle-power is always to be measured with the lamp rotating about a vertical axis at 200 r.p.m. The ratio of mean spherical to mean horizontal candle-power, or the mean spherical reduction factor is not to be less than 0.8. This would tend to rule out some lamps of large end-on candle-power. It will be noted that the standard set is rather low. The useful life to 80 per cent of normal candle-power is set at 400 hours for the higher efficiency lamps and at 800 hours for the lower efficiency lamps.

We now have to recognize the pentane lamp candle-power of England, the carcel of France, the hefner of Germany and the old parliamentary candle-power of the United States. It would seem desirable to suppress unnecessary reduplications of standards and for all civilized countries to use one and the same working standard of light. This might be done by reference to any one accepted primary standard by having an international committee calibrate seasoned incandescent lamps with reference to that standard. A large number of secondary standard incandescent lamps could then be made from the primary standards of the committee and copies kept in each national physical laboratory. Every few years a fresh set of determinations might be made between reference lamps in these laboratories. In this manner the incandescent lamps of all civilized countries might be calibrated, say, in hefners, without danger of departing sensibly from an international common unit.

Control of Lamp Renewals.

While the policy of furnishing free lamp renewals has been generally accepted by the larger companies of the country as the one most conducive to good lighting service and least likely to give rise to complaints from customers as to poor lamps and excessive bills, there are so many companies which do not furnish free renewals, but which nevertheless would like in some way to control the kind of lamps which are placed on their lines that there is interest in compromise schemes which give the central station company virtual control of the kind of lamps used without entailing on the company the expense of free renewals. One plan sometimes adopted has been for the company to sell efficient lamps at less than cost to prevent local storekeepers from selling cheap low-efficiency lamps to customers. A plan which has been worked in one Western city seems to control the situation even better than this and at no expense to the central station company. In the city in question the central station has never furnished free lamp renewals, but at one time was seriously considering doing so. The local supply dealers who had been selling lamps were fearful lest the central station should inaugurate a free renewal policy and cut them out of a certain amount of business. The central station company was, therefore, in a position to say to these supply dealers that it would not adopt the free renewal policy provided the supply dealers would all agree to sell only lamps of a specified efficiency and quality. This the supply dealers readily assented to, with the result that the central station company practically has control of the lamps which are sold to go on its lines without having the expense of free renewals. The only disadvantages of this plan as compared with the regular free renewal plan is that customers are more likely to leave some of their sockets empty for considerable periods of time than if renewals were free.

What Is a Fair Growth of Central Station Business?

At the close of a year which has been marked by active efforts to increase output by many central station companies, managers are naturally asking themselves the question, "What is a fair rate of increase in the central station business?" and "How much would the natural increase amount to without solicitation?" There is no doubt whatever that the business in some cities with but little solicitation will show an increase fully equal to that in other cities where very strenuous efforts have been made. In some of the larger cities of the Middle West annual increases of 30 per cent and over have been common for a number of years past. In most of these cities there has been considerable effort to get new business, so it is difficult to say what the increase would have been without any new business campaign. The contract agent of one well-known company in which the annual increase both in peak load and output is about 35 per cent, counts the natural increase

as about 10 per cent. There are so many factors entering into the natural increase that it is impossible to lay down any rule even assuming a uniform prosperity all over the country. Some cities are growing faster than others, some are growing in wealth faster than in population, and some have more active gas companies than others. Central station managers would be wise not to attempt to determine what the natural rate of increase would be in their respective cities without any new business campaign. Too many have that figure already. Such figures may be very interesting from an academic standpoint, but are of little practical value, and the amount of time spent in their determining will make them entirely too costly. An active campaign with solicitation and advertising is much more to the point.

Effect of Iron in Distorting Alternating-Current Waves.

A few months ago a paper was read by Dr. Frederick Bedell and Mr. E. B. Tuttle before the American Institute of Electrical Engineers upon the above topic. Starting with a given sine wave of current in an iron-cored coil, the authors showed that the triple-frequency harmonic which could accompany that fundamental—in the absence of higher harmonics—is limited to a strength of from 19 to 33 per cent of the fundamental, according to the phase displacement between the fundamental and the harmonic. By associating such triple-frequency harmonics with a fundamental current wave, various $\mathfrak{IC}$ $\mathfrak{B}$ hysteresis loops were determined and compared. The discussion on the paper has now been published and forms an excellent supplement to the paper. Dr. Steinmetz shows in the discussion that it is desirable to include higher frequency harmonics than the third, notwithstanding the greater degree of complexity thereby produced. He also illumines clearly the essential difference between "hysteretic losses of power" and "molecular magnetic friction." This is a distinction often lost sight of, and though often of no practical importance, occasionally cases may arise in which it is important. When, for example, an induction motor is operated at stand-still, like an ordinary transformer, there will be loss of power in the rotor core, due to molecular magnetic friction, which accompanies the hysteresis or lagging behind of the magnetism of the core behind the rotating field. This power will be supplied by the alternating-current circuits and the currents in those circuits, when plotted to suitable coordinates, will display the usual hysteresis $\mathfrak{IC}$ $\mathfrak{B}$ loop. If, however, the rotor be driven above synchronism by power, as in an induction generator, there will be a similar loss of power in the rotor due to molecular magnetic friction, but the power will be supplied by the driving engine. There is no longer a negative hysteresis loop of current, but on the contrary a reversed loop of leading magnetism. The cycle of $\mathfrak{IC}$ $\mathfrak{B}$ variation in the stator is no longer a cycle of hysteresis or lagging behind, but a cycle of advance, or leading ahead.

While, therefore, it is proper to speak of the generic phenomenon of hysteresis in iron, by virtue of which magnetic changes are automatically retarded and opposed by intermolecular magnetic frictions, the loss of power occurring in iron is more strictly described as molecular magnetic friction, than as a loss due to hysteresis, or lagging of magnetism behind exciting current.

The Colors of Recent Illuminants.

With the advent of illuminants of very high efficiency it would be natural to suppose that the color question would take care of itself, always providing that the light is not colored like that of the mercury arc, or of the ordinary form of the flaming arc. When incandescent lamps reach the efficiency obtained by the Nernst glower, tantalum, osmium and tungsten filaments, one naturally expects that the color will be sufficiently near to white and compare favorably with any known artificial light. These modern lamps are, of course, a great improvement over the ordinary incandescent in point of color, but it seems doubtful whether even the best of them is white enough to permit the finest kind of color discrimination. There is, to be sure, no standard white and no terms in which to classify these or any other illuminants. Even sunlight varies from white, or bluish white, when the sun is high, to orange when it approaches the horizon. If one could see a pile of colored fabrics simultaneously in the light of the noon-day, and the setting sun the contrast would be startling to the last degree. Still more extraordinary would be the result could one see a third pile of similar fabrics illuminated by the light of a north window, which is far bluer than any artificial illuminant, except possibly an enclosed arc of low amperage. As compared with sky light all incandescent lamps, even including the tungsten light, look yellow. In this general uncertainty it might seem a matter of comparatively little consequence whether a given illuminant varied slightly in the direction of yellow or of the blue, from what one might be pleased to call normal white.

Experience, however, shows that even these comparatively small variations may make themselves felt in a very striking way. For instance, in a certain factory producing colored articles covering a very wide range of slightly differing shades, experiments were recently tried in performing the necessary sorting of shades under several forms of artificial lights. The results of this test showed that incandescent lamps, even when as near white as the Nernst lamp, failed to give the necessary power of discriminating between closely allied shades, and the ordinary enclosed arc was, through error on the side of the blue, equally unsuccessful, and by far the best results were secured with an arc lamp with relatively large amperage. Even in the arc it seemed to be necessary to push the current density in the arc very high in order to obtain a light of first-class color. This may be done either by using very powerful arcs and large amperage, or by using a comparatively small carbon with moderate current. Some arc lamps are now on the market using carbons of as little as 5 mm. diameter, and with this it is, of course, practicable to obtain an arc of moderate power and good color. A larger carbon with larger current attains the same result. It will be interesting to observe whether an incandescent lamp even of considerably higher efficiency than any now in use, will be able to give a color effect practically as good as that attained with arc lamps. Of course, the temperature of the crater in an arc worked at high current density is considerably higher than that of any incandescent filament yet produced. The practical question involved is whether the color quality necessary for the finest discrimination between tints can be obtained at the temperature of the one or the other. So far no experimental data sufficient for answering this question are at hand, and investigation to determine the facts of the case are certainly in order.

Report of New York Gas and Electricity Commission.

Details have been given out in abstract of the annual report of the New York State Commission of Gas and Electricity. In this second report the commission makes several recommendations to the Legislature. The one it considers the most important has to do with the question of complaints as to price, purity and quality of gas or electricity. As the law now stands complaints can be made to the commission by the proper municipal authorities or by one hundred or more consumers of gas or electricity in the territory of the company complained of. The commission recommends that the law be amended so that complaint may be made by 25 customers in the territory served where it contains less than one thousand population, by 50 customers where the population is between 1,000 and 5,000, by 75 customers where the population is between 5,000 and 10,000, and 100 in all other places. The amendment would make it possible for the consumers in any community in the State who consider themselves aggrieved to have an investigation and the price regulated.

The commission also recommends an amendment to the law which will require a company incorporated before the law went into effect to obtain the consent of the commission before exercising its powers under a franchise hereafter obtained from the local authorities. Such companies are now free to invade the territory of established companies without first obtaining this consent. Other recommendations are: That authority be given to the commission to revoke all certificates of authority to transact business where the construction of the plant in question is not begun in good faith within a certain period from the date of issuing such a certificate; and that municipal gas or electric plants should be compelled to make annual reports to the commission.

The commission calls attention to the fact that no provision is made, upon the application of a company, for a revision of prices after the expiration of three years for which the price is fixed. The commission considers it to be only fair that a company should have the same right as the consumers to apply for revision of price fixed by it as changing conditions might increase the cost of production and distribution.

The report shows that there is a total of 426 corporations, municipalities and individuals furnishing gas or electricity for light, heat or power in the State coming under the supervision of the commission. The capitalization of these companies aggregates $456,000,000, and the gross income from operation approximates $75,000,000 per annum.

During the year ended December 31, 1906, the commission had before it for consideration 74 applications, upon all but three of which public hearings were had. The applications of 29 companies for certificates of authority for consent to issue stocks or bonds and for consent to increase issues of stock or bonds were passed upon by the commission. The capitalization asked for aggregated $9,492,000, while the amount allowed by the commission was $6,837,000, a reduction of $2,655,000, or approximately 28 per cent. In reducing the amount of stock and bonds applied for the commission followed its policy of requiring each company applying for consent to make such issues to furnish the commission with a statement in detail as to the purposes for which the proposed issue was to be used. In no case did the commission allow an issue except for actual improvements and extensions to plant.

The commission received complaints as to the price and quality of gas or electricity from Albany, Buffalo, Rochester, Watertown, Mount Vernon and Nyack, and it is now conducting an investigation into each of these cases. Complaints were filed with the commission prior to January 1, 1906, against the Consolidated Gas Company, of New York, and its subsidiary companies: the Brooklyn Union Gas Company, the Syracuse Lighting Company, the Plattsburg Light, Heat & Power Company, the Lozier Light, Heat & Power Company and the Auburn Gas Company. The report reviews the results accomplished by an investigation of the complaints. During the year reductions in the price of gas were made in fourteen cities and towns of the State. Reductions in the price of electricity also were made during the year in more than thirty cities and towns. The amount of gas sold to consumers and for public lighting during the year was 39,858,755,381 cu. ft., as against 37,914,016,400 cu. ft. for the preceding year, an increase of about 5 per cent.

The commission has notified the various companies in the State that it has under consideration a preparation of a uniform system of bookkeeping and has invited them to furnish a classification of accounts employed and to offer suggestions. Many companies have responded and with this as a basis there has been outlined for adoption a system of accounting which is adapted to small as well as large companies.

New York, Cuba and Colon Cable.

At Washington, on January 30, Attorney-General Bonaparte, Secretary of War Taft and General Allen, chief signal officer of the army, discussed the application of the Central & South American Telegraph Company to land an ocean cable connecting the United States with Cuba and the Canal Zone. The company proposes to lay a cable from Sandy Hook to Guantanamo, Cuba, and thence to Colon or Cristobal, connecting by land lines across the Isthmus with the Pacific cables.

The Government will agree, as a result of the conference, to the laying of the cable as proposed, but it will effect an agreement with the company by which the United States will have control of the line in time of war. This will be done by exercising control over the landing places of the cables. It is believed by the Government that this line will be a great advantage to the United States, in that it will insure direct cable communication with Cuba and the Isthmus without passing through Mexico or other foreign territory. The cable will be about 2,500 miles in length and will cost about $1,220,281.

Pressure on the three Gulf lines owing to the increase of business of the Central and South American Telegraph Company has been so great that the laying of another cable has become absolutely necessary. The directors decided it would be better to lay one between Colon and New York, which would relieve the congestion and at the same time make it possible to deliver messages without the delays which result from transmission by land lines. The other cables controlled by the company are carried to Galveston, Texas, and from there the messages are sent overland to New York.

The South American cables of the company extend down the Pacific coast to Valparaiso and are carried across the Andes to Buenos Ayres, from which point they are carried along the Atlantic side of South America. The time of transmission between Buenos Ayres and New York, via Galveston, has for several years been under thirty minutes. It is believed the Colon cable will materially lessen this and greatly increase American and European South American traffic.

Helion Lamp.

At a meeting of the Electrical Engineering Society of Columbia University, held on February 5, Prof. H. C. Parker and Mr. W. G. Clark gave a working demonstration of the properties of their recently developed Helion lamp, which was described in our issue for January 5. The extremely high illuminating efficiency of the lamp was conclusively shown by comparison with a carbon lamp consuming the same amount of power and giving what appeared to the eye without photometric measurements to be from one-fourth to one-third of the candle-power of the Helion lamp. Several new mechanical arrangements of the filaments were illustrated, but no additional information was given concerning the life of the lamp. The new lamp and its remarkable characteristics were discussed by Professors F. B. Crocker and G. F. Sever, Messrs. J. W. Lieb, J. W. Howell, W. J. Hammer and Dr. A. S. McAllister.

Electrical Apparatus in the Philippines.

The American Chamber of Commerce of Manila, P. I., is pushing its advocacy of the legislation for free trade with the Philippines. Its documents contain some interesting figures as to the nature and value of the American electrical exports into the islands. The total of heavy electrical machinery imported in 1905 was $235,330, of which $230,086 came from the United States. During that year there was an unusually large importation of such apparatus, but there is reason to believe that a large demand can be created and maintained.

As to instruments and apparatus for scientific purposes, including telegraphs and telephones, the following statement is presented: The total importation of this class of goods in 1903 was $49,088; in 1904, $52,394; in 1905, $122,421. The United States furnished over 50 per cent of the total in 1903, about 68 per cent in 1904 and over 80 per cent in 1905.

The greatly increased importation in 1905 over the preceding years is accounted for by the installation of a new telephone system in the city of Manila, and the changing of the electric light system from an old plant to a new one, necessitating the use of many new appliances and fixtures. A proportionate increase is shown in the importation of electric lamps, which increased from $6,364 in 1904 to $12,917 in 1905.

Of the last total the United States furnished $9,987 worth, or about 75 per cent, while in 1904 less than one-half of the total came from the United States. It will thus be seen that the principal increase has gone to the United States.

This business is practically in its infancy. There are only two electric light plants outside of the city of Manila, besides one or two operated by the United States Government at army posts, and there are few telephone companies outside of one in Manila, although the Government has some lines on different islands of the archipelago. As the country is developed there will naturally be a vast market opened up for all goods of this description, and with the passage of the Philippines bill, which provides for free trade between the Philippines and the United States, American manufacturers will have an additional advantage in competing for this business.

New Telephone Exchange for Worcester, Mass.

On February 2 a new telephone exchange was cut into service in Worcester, Mass., by the New England Telephone & Telegraph Company. Worcester was one of the first cities in the country to be equipped with a common battery switchboard, and about ten years ago, when there were 1,200 subscribers on the system, the old central office was moved into a specially constructed building on Norwich Street. Since that time the Worcester exchange has shown a net increase of about 100 subscribers a month, and at present the average number of calls per day is about 64,000, or one conversation for each pair of the 130,000 inhabitants of the city each 24 hours. About 60,000 are local calls and 4,000 toll conversations, and 10 per cent of the traffic is handled in the busy hour. Of a total force of 100 local operators and 46 toll operators, 48 are required at the local board and 25 at the toll board to handle the traffic in the busy hour.

Three years ago the main switchboard was extended, but to accommodate the increase of business, including the district organization set up in Worcester a few months ago, a large extension was made to the company's building, the addition being nearly the size of the original structure. The new local exchange equipment is in the addition to the main building, which will be opened at the time of the cut over. The operating room is located on the top floor and is lighted by both skylights and windows, the board occupying three sides of the room.

The new switchboard will have a capacity of 10,400 lines when full, of which 7,200 lines are newly equipped. The old apparatus had about 4,000 subscribers' lines in use, with more than 9,250 stations connected. Two special features of the new board are its jack-per-station equipment for two-party lines and the reservation of several positions for prepayment instrument service. Selective ringing is applied only to two-party lines, and the prepayment service is given by coin box instruments. Seventeen outlying towns near Worcester are an integral part of the Worcester exchange with reference to toll service.

Problems in Electrochemistry.

In reply to a request made to its members by the Electrochemical Society, the following problems have been submitted as topics for discussion before the society and also as subjects for special investigations to be rewarded by the bestowal of prizes:

1. Fixation of atmospheric N by electric current.
2. Production of HCl from electrolytic chlorine.
3. Decomposition voltages of salts in fused condition.
4. Conductivity of various fused baths.
5. Heat of formation of alloys and alkaline and alkaline earth metals with "heavy" metals.
6. Direct electrolytic separation of Zn from ZnS concentrates, or roasted ZnS. (Fused bath.)
7. Search for electrode and furnace materials which will resist various fused baths.
8. Uses of Cl and the several alkali and alkaline earth metals.
9. Investigation as to relative melting points of the rarer elements and oxides from 1,200° to 2,800° C.
10. Anodic behavior of carbon electrodes in relation to the combination of carbon, hydrogen and oxygen—an application of electrochemistry to one of the fundamental problems of organic chemistry.
11. The mechanism of the reactions which result in ferrate as one of the products of the electrolysis of alkaline chloride solutions, and the conditions governing the amount produced.
12. Are catalytic reactions electrochemical?
13. The resistance and temperature coefficient of various metals and alloys.
14. The electromotive forces between different metals and solutions.
15. Phenomena in a porous diaphragm.
16. Intermediate electrodes.
17. Does it take more electromotive force to deposit from an electrolyte a liquid metal than a solid metal?
18. Electric conductivity of melted metals, at various temperatures.
19. Preparation of carbon black from natural gas.
20. Thermochemical data for carbides.
21. Does the presence of an electrically conducting pigment in a linseed oil paint applied to an iron structure tend to promote corrosion?
22. The conditions affecting the corrosion of steel and other alloys.
23. Data with regard to the deterioration of graphite anodes at different temperatures, with different fluxes and slags and with reference to possible specific gravities of the graphite electrodes.
24. Effect of temperatures (aqueous solutions) on the life of graphite anodes (*a*) stationary electrolyte, (*b*) circulating electrolyte.
25. The production of metallic antimony from stibnite.
26. A further investigation of the ionization of carbon, and experimental work tending to utilize carbon directly for the generation of electricity.
27. Is the electrolytic preparation of bleaching solution for pulp a success?
28. An economical method for the recovery, by electrolysis, of the copper contained in the water pumped from copper mines. The composition of this water is as follows:

	Grams per liter.
Free sulphuric acid	0.1200
Arsenic	0.00915
Antimony	0.00570
Copper	0.1573
Iron total	0.2310

The copper and iron are both in solution as sulphates. Large quantities of this water are pumped from the Butte and other copper mines, and the present practice is to run the water over scrap iron and obtain a precipitate running 50 per cent copper, which is subsequently treated in furnaces with more or less loss.

29. The behavior of metallic silicon as an anode in chloride solutions.

30. The study of the law of energy in electrochemical reactions, including the disputed question whether, in electrochemical decompositions, the compound will first decompose which requires the least energy to decompose it; also including the question whether a compound can be decomposed with a voltage less than that required by Berthelot's law.

31. When a horizontal anode is placed about a half or quarter inch above a layer of mercury and in a solution of acidulated zinc sulphate, the mercury being the cathode, hydrogen will be evolved freely from the mercury at moderate current densities; when the current is then increased a point will be reached when no trace of gas is evolved immediately below the anode (which should be smaller than the cathode) while outside of this area there will be free gasing. What takes place over the non-gasing area, and can the phenomena for the deposition of the zinc in the mercury take place without the evolution of hydrogen?

32. A study of the thermoelectromotive forces between solids and liquids. They are very much greater per degree than those between solids.

33. The heat conductivities of linings for electrical furnaces; the temperatures and conditions under which the linings of electrical furnaces become electrically conducting, and the specific resistances under these conditions and at these temperatures.

34. Is it possible to have electrolysis without electrodes; if so, what takes place, and where?

35. In the electrolysis of acidulated water, when using the same anode it will require widely different voltages to set free hydrogen with different metals for the cathode; it will be least when this metal is platinized platinum, and quite great when it is mercury. The excess of voltage over that in the former case has been called "over-voltage." What is the seat of the energy represented by this excess of voltage? What does this energy do, and in what is its form after the reaction?

36. If a glass tube is filled with an electrolyte in solid form and provided with electrodes at both ends, and if, by the application of heat to one end, this electrolyte becomes a liquid at only one electrode—at what place will the electrochemical reaction, corresponding to that at the other electrode, take place if the electrolyte is of such a nature that it changes gradually from the solid to the liquid state, passing through a semi-liquid state? It cannot take place in the solid part, there is no definite line of demarkation between the solid and liquid parts, yet it must take place somewhere, as a unipolar electrochemical reaction is unknown.

37. If an electrode of zinc and another of amalgamated zinc be placed in a solution of zinc and the electrodes connected externally, a current will flow in the external circuit from the zinc plate to the amalgamated one and zinc will be deposited at the former. What is the source of energy of this battery? It has been thought to be thermal, and that the liquid cools by virtue of this reaction, thereby absorbing heat from the air. If so, it would offer a direct means of changing the heat energy of the air into an electric current, and would seem to be contrary to the second law of thermodynamics.

38. Electrolytic production of magnesium.

39. Electrolytic method for determining silver in base bullion and doré bars.

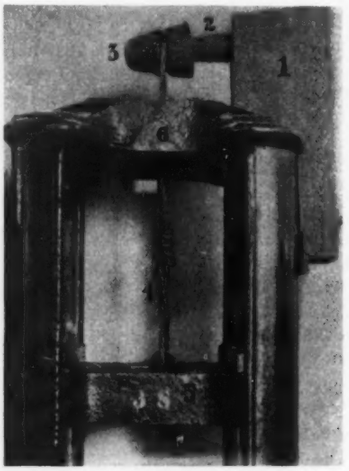
40. What is the white substance formed on copper anodes when refining copper with a high current density and a cold solution?

Strength of Insulator Pins.

At the request of certain consumers, the Forest Service of the United States Department of Agriculture recently made tests on fifty-three insulator pins of rock elm, live oak and black locust. The tests were made at the timber-testing station of the Forest Service at Purdue University, Lafayette, Ind. The results indicate the relative strength of the pins tested, although they depend upon too small a number of tests to show in an authoritative way the relative value of these woods.

The pins were of standard size, 1¼ in. by 8 in. The oak pins were from ⅛ to ¼ in. shorter than the others, and of slightly smaller diameter at the shoulder. Their lever arm was also about ½ in. shorter than in the cases of the other two species.

In testing the pins an iron block was clamped to the stationary upper head of a small screw-testing machine, as illustrated



TESTING DEVICE FOR INSULATOR PINS.

herewith. The pins were inserted to a tight fit in a hole in this iron block, and projected horizontally over the pulling head of the machine. The glass insulator was unable to bear the strain of the wire, so an iron model of the ordinary glass insulator was screwed on the pin and connected by means of a heavy wire to the pulling head of the machine. When a strain was put on this wire, the pin acted as a beam fixed at one end and loaded at the other, which is practically the condition met with in practice. The breaking moment (maximum load in lbs. times the lever arm in inches) was taken as a measure of the strength of the pins.

The tests showed that the breaking strength of the black locust pins was roughly 4,000 in.-lbs., of the live oak pin about 3,000 in.-lbs., and 2,500 in.-lbs. for the rock elm pins.

The locust and elm pins failed mostly by splitting from the threads to the shoulder, or by tension at the shoulder. Occasionally the portion of the pin inserted in the block failed by shearing horizontally. The oak pins nearly all failed by tension at the shoulder.

Commercial Relation of Sunlight and Electric Light.

The effect of the past month of dark days on consumption of electrical energy is notable, and some very large outputs have been recorded. The central station managers of the country are inclined to adopt with complacency the motto: "Count only the dark hours," as therein lie the dividends. Commenting on the fact that December and January have been darker than for years past, the New York *Evening Post* says:

"As a result of the past month of preponderant gloom, the lighting men of the up-State region have been put to extremities to supply a substitute for the fickle and remiss sun. It

has been a hard fight to keep the whining dynamo and sagging tank ahead of the imperative calls of button and jet; but in almost every instance the emergency has been tided over. The winter of 1906-7 will always be remembered as a campaign, however, by the men whose business it is to understudy the sun.

"A scientific and exhaustive study of the caprices of the great lightmaker is to be made by the lesser ones, as a result of the extraordinary conditions which have obtained thus far this winter. The matter has been called to the attention of the Empire State Gas and Electric Association, an association of lighting men of the up-State territory, and plans have been proposed for obtaining exact records of the variations of sunlight during every hour of this record period of darkness. The co-operation of scientists and Government experts will be invited and a determined effort made to obtain some definite insight into the causes and probabilities of sudden, untimely and extended obscurity in the sun's rays.

"Philip T. Glidden, of Binghamton, has already begun, in the interests of the association, an investigation of the instruments and methods employed in the Government service for observing and recording the variations in the sun's illuminating power. He is working out an instrument which, when perfected, is designed to record not only the periods of sunlight and unobscurity, but the most minute gradations and variations between them at every minute during an overcast day.

"There is a delicate art in raising or lowering the efficiency of a lighting system in accommodation to a demand as fluttering as a feather. The lighting men believe that the sun has as sensitive a system in its function as a light generator. At the present time the two are not in touch, and the human supplement labors clumsily, and at great cost and worry, to attend upon its great prototype. To 'tune up' the two is the object which, it is believed, will ultimately be obtained."

Alternating-Current Machine with Shunt Motor Characteristics.

Under date of January 1 three patents were issued to Mr. B. G. Lamme, one to Mr. C. Renshaw and one to Mr. Lamme and Mr. Renshaw as co-inventors, dealing with the common subject of an alternating-current machine possessing the characteristics of a variable-speed shunt-wound, direct-current motor. Since the armature may be, and ordinarily is, surrounded with a stationary compensating coil having minimum local

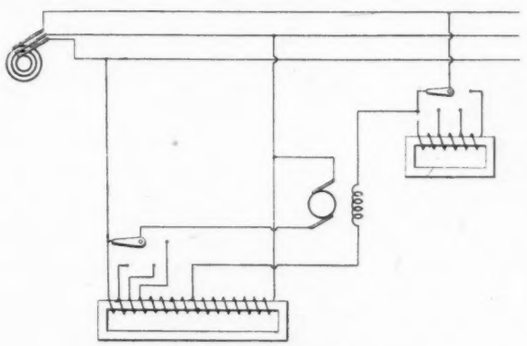


FIG. 1.—LAMME MOTOR.

leakage reactance, the current in the armature and compensating coil circuit lags very little behind the e.m.f. impressed upon it. In the field magnet winding, however, the current lags nearly 90 time degrees behind the e.m.f. impressed upon that circuit. The e.m.f. generated in the armature is in time phase with the field flux, hence it is in time quadrature to the field circuit e.m.f. It would seem, therefore, that if the e.m.f. applied to the field circuit differs 90° in time phase from that across the armature circuit, the currents in the two circuits will differ very little in phase. The inventors propose to employ a polyphase generator as a source of power for the motor. One of the simplest schemes is shown in Fig. 1, where the auto-transformer is used to obtain a variable e.m.f. for the armature, while its central point affords a convenient connecting tap for giving the proper quadrature phase position to the e.m.f. impressed across the field circuit, the variable impedance in series with the field coils serving to adjust the field

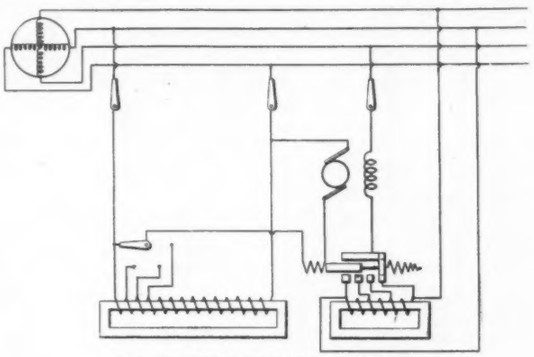
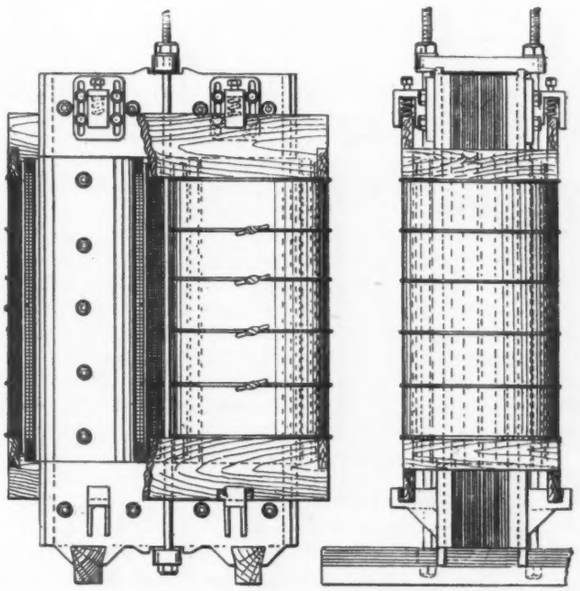


FIG. 2.—RENSHAW-LAMME MOTOR.

current to the desired value. The several patents relate to methods and means for varying the field circuit current both in value and in time phase position automatically with change in the value of the armature current, one of the schemes proposed being indicated in Fig. 2, where the source of supply is a two-phase generator.

Flexible Transformer Construction.

Mr. A. H. Pikler was granted a patent on January 15 for a scheme for so assembling transformers and similar apparatus that proper provision is made for the variability in the sizes



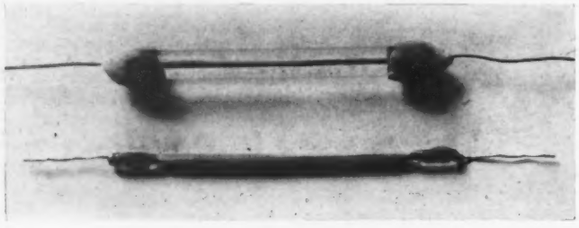
FIGS. 1 AND 2.—PIKLER TRANSFORMER CONSTRUCTION.

of the coils which may be caused by temperature changes or otherwise during transportation or operation. Referring to the accompanying illustrations, it will be noted that the high tension coils are concentric with and exterior to the low-tension coils, and are spaced therefrom for ventilating or for oil circulation. Owing to the separable character of the core-frame all the coils are wound apart from the core and assembled on

the legs after winding. The high-tension coils are supported and clamped between frames of wood, at each end of the coils. Brackets project from the yokes of the core, and set-screws in the brackets at one end bear against springs, placed between them and the frame at that end. The springs automatically take up all small changes in the thickness of coils arising from contraction and expansion due to temperature variations, preventing them from becoming loose and protecting them from any stresses that might prove to be injurious to their insulation.

Incandescent Film Lamp.

In addition to their Helion filament lamp Prof. H. C. Parker and Mr. W. G. Clark have in process of development an interesting form of lamp for constant-potential circuits, the light from which is developed in a conducting film lining the bore of a small quartz tube. A patent on this lamp, issued February 20, 1906, was noticed in our issue of March 3, 1906. Last week a board of officers representing the Army and Navy Departments and the Lighthouse Board inspected the new lamp at Columbia University, and will report on the question of its adoption for use in the services which the members represented. The board consisted of Rear-Admiral Clifford H. West, U. S. N.; Lieut.-Commander W. S. Crosley, U. S. N.; Lieut.-Col. F. V. Abbott, U. S. N.; Major L. A. Abbott, U. S. A.; Col. Amos Stickney, U. S. A., and Col. William M. Marshall, U. S. A. One of the points which attracted the attention of the Government depart-



TUBES OF INCANDESCENT FILM LAMP.

ments to the lamp is its adaptability for use where there is violent concussion from the firing of ordnance, which is destructive of the ordinary filament lamp. The heavy quartz tube of the new lamp will withstand such shocks and a vacuum in the tube is not necessary.

The accompanying illustration shows two of the tubes. One is a plain tube and the other has a coating of thorium oxide. One of the interesting features of the lamp is that the quartz tube permits the passage of the short wave lengths of ultra-violet light. The conducting film gives off a quantity of such rays, and it was found that the efficiency of the lamp could be increased by coating the surface of the tube with thorium oxide, which under the combined influence of the heat and ultra-violet rays, glows with the characteristic light of the Welsbach mantle. The consumption of energy with the plain tube is about 2½ watts per candle.

Submarine Signal Bells.

Submarine signal bells along the Atlantic coast are "making good," according to frequent reports received from captains of ocean and coastwise steamers. It was blowing a gale from the northeast on January 17, with thick snow, when the officer on the bridge of the *Kaiserin Auguste Victoria* heard the Sandy Hook Lightship bell five miles away. On the same day the captain of the pilot boat *Ambrose Snow* heard the same bell at a distance of six miles. The captain of the *H. F. Dimock* heard the bell on Cornfield Lightship 25 minutes before the whistle was audible. The Cunard liner *Saxonia* heard the bell on the Boston Lightship on January 17, when it was about five miles away.

CURRENT NEWS AND NOTES.

ELECTRIFYING THE ERIE.—The newspapers contain a great deal of talk about the early expenditure of $12,000,000 in electrifying the Erie Railroad suburban system, but it does not appear probable that all this amount will be spent in 1907 or even in 1908. The extension of the electrical work will be gradual and conservative. The company has already electrified two of its branch lines in New York State, both on the single-phase system, accounts of which have been printed in recent issues of this paper.

MOVING PLATFORMS.—The Prospect Heights Citizens' Association, an influential civic body in Brooklyn, listened at the Berkeley Institute, on February 5, to an interesting illustrated address by Mr. Max E. Schmidt, on the moving platform and its availability for lessening the bridge congestion and improving transit conditions between the two boroughs as well as in rendering new subway travel better. Mr. T. C. Martin spoke of favorable experiences with moving platforms in Chicago in 1893, and Paris in 1900. Mr. Ludwig Nissen also spoke of personal observations and as a citizen interested in the adoption of such remedial measures. The association has declared itself strongly in favor of municipal efforts toward the adoption of this meritorious engineering plan.

TRÖLLHATTAN POWER.—The largest power station in Europe is about to be built at Tröllhattan, Sweden. The Tröllhattan Canal & Water Works Commission has handed in two propositions concerning the plant. In one plan the whole available power, which is about 76,000 electrical hp, will be used, and at a cost estimated at 11,300,000 kroners. The other will use 28,000 hp and will cost 8,500,000 kroners. In the last-named proposition 10,000 hp could be transmitted to Göteborg, 10,000 to places within 60 miles of Tröllhattan, and 6,000 for manufacturing plants in the neighborhood. The *Svenska Dagbladet* thinks that the first-named proposition will be the one next to be accepted. The Swedish railways will require about 20,000 hp, which will be used on that section of the railroad between Falköping and Göteborg.

LONDON TRAMWAYS.—A special correspondent of the New York *Sun* contributes a very interesting article on the cost of public ownership in London, and among instances cites the trolley system. There are in London two tramway systems, one north of the Thames, the other south of the river. The County Council became possessed of both in 1900. The capital value was approximately the same, $4,250,000 on the north $4,480,000 on the south. The council leased the northern lines to a company and worked the southern lines itself. During the period the council has electrified the southern lines, which has slightly interfered with their working, but the result of five years' operations is instructive. The fares have been the same on both. The council figures out a profit for the five years on its lines of $119,500. During the same period the lessees of the northern lines have paid the city $958,000. But, as Lord Avebury points out, even the claims of the council to a profit of $119,500 will not bear examination. The auditor of the Local Government Board has objected to the insufficiency of the sum set aside for renewals, etc., and to the method by which only one-third of the cost of street widening for tramways is charged to tramway account. The sum set aside for depreciation is only 1.1 per cent. The sinking fund amounts to only 2 per cent, so the total allowance for renewals and depreciation is only 3 per cent, a totally inadequate allowance according to ordinary business standards. Moreover, nothing at all has been debited for central office charges, these expenses having been charged to the council's ordinary expenditure. If these proper deductions had been made, Lord Avebury points out, the imaginary profit would have been turned into a loss. But after this lamentable experience the council has decided not to lease the southern lines to a company, but to operate the northern lines itself.

WORCESTER POLYTECHNIC DINNER.—The annual dinner of the New York alumni of the Worcester Polytechnic Institute was held in this city January 29, with President A. A. Cary in the chair, when over a hundred were present. The dinner was given at the Hotel Normandie on upper Broadway, and was historical as being the first at which telharmonic music was given throughout, not only as a steady programme, but as an accompaniment to the college songs. The Cahill plant of the New York Electric Music Company is about a block from the hotel. After the dinner Mr. Carl M. Piehl, manager of the music company, gave an excellent address on the new art and then a *tour de force* was accomplished in giving a well-known composition while on a screen pictures were thrown by a biograph showing the performer at the keyboard in the distant music room. This effect literally brought down the house and was at once clever and successful. Among the speeches was one by Prof. Smith dealing with the splendid new electrical laboratory now being constructed for the Institute under the Salisbury gift.

ADVANCED TELEGRAPH RATES.—Advices from Chicago state that a committee of the Board of Trade will confer with a committee of other exchanges regarding steps to compel the telegraph companies to rescind an advance in tolls which amount to $150,000 to $200,000 in the case of the former alone. Agitation has been started to build independent telegraph lines. The companies' excuse for the new rate that the law compels them to charge the same rate from the exchange floors as the public pays for delivered messages is ridiculed. In New York the Western Union and Postal Telegraph companies have notified the Produce Exchange management and other senders of commercial messages that the Chicago rate on such messages will be raised from 25 cents to 40 cents. It makes the rate on commercial messages the same as that on personal messages, and the change was necessitated, it was said at the Western Union offices, by the railroad rate bill, which forbids discrimination in interstate commerce. Previously the Produce Exchange and other organizations with a large business have received a cut rate. The new rule makes no difference in the charges for leased wires.

A. I. E. E. AT SCHENECTADY.—At the regularly weekly meeting of the Schenectady branch, American Institute of Electrical Engineers, held January 31, Ernst J. Berg, of the General Electric Company, read a paper on "Line Constants and Abnormal Voltages and Currents in High-Potential Transmissions." This was the second in a series of lectures which Mr. Berg is giving before the branch on the generation, transmission, transformation and application of alternating currents. Printed copies of the paper, which dealt with the subject mathematically, were distributed among the members and the speaker abstracted the text and supplemented it with explanations of the derivation and use of the formulæ and their application to practical problems. Among those who discussed the paper were Messrs. Steinmetz, Eveleth, Creighton, Alexanderson, Summerhayes and Du Bois, and many interesting reminiscences of experiences with high-tension lines were recounted. Before the presentation of the paper there was a discussion of Institute affairs and the approaching nominations for president. The ideas of a number of local men prominent in the work of the national body were endorsed by the branch, by passing unanimously a resolution recommending the nomination of Mr. H. G. Stott, of New York, for president, for the term 1907-8.

INSECTS EAT LEAD COVERING.—Reports sent out from Chicago several days ago to the effect that trouble had been experienced in a stockyards plant with the destroying of the lead covering of insulated wires by insects seemed almost incredible; but upon investigation by the local staff of the ELECTRICAL WORLD are found to be correct. The trouble was experienced in the S. & S. Co.'s packing plant in the vicinity of places devoted to storage of hoofs preparatory to making glue. The trouble occurred on watchmen's circuits, which were run in lead-encased cables. About 300 ft. of such cable has had to be taken out on account of the work of the insects. The insect is one which has been investigated by the Field Columbian Museum experts in Chicago, who report that it is commonly found in decaying animal matter, but not likely to breed anywhere else. It is the larvæ or grubs that do the damage. These larvæ burrow through wood to find a secure place in which to undergo metamorphosis to the beetle stage of development. In burrowing through the wood they came across lead cables with results disastrous to the cables. The trouble is one which is not likely to occur anywhere but in certain places in packing plants, and is easily remedied by different electrical construction.

TECHNICAL PUBLICITY ASSOCIATION.—"Sales Night" of the Technical Publicity Association was held at the rooms of the Aldine Association, New York, Thursday, January 31. The association received the first report of its circulation committee, which has been requesting reports on circulation, etc., from the various technical magazines in which T. P. A. members are interested. As was expected, the stronger magazines have shown themselves eager to go on record with detailed statements. The companies represented by members at the meeting were: Yale & Towne Manufacturing Company, Johns-Manville Company, American Wood Working Machinery Company, F. R. Almond Manufacturing Company, General Electric Company, Crocker-Wheeler Company, American Locomotive Company, Cameron Steam Pump Works, New York Telephone Company, New York Edison Company, B. F. Sturtevant Company, A. A. Griffing Iron Company, A. Allan & Son, Goulds Manufacturing Company, Prentis Tool & Supply Company, J. G. Brill Company and Lidgerwood Manufacturing Company. Mr. J. Robert Crouse, organizer and manager of the Co-Operative Electric Development Association, described his plan, already well under way, to stimulate the use of electric current in every branch of industry throughout the country, and Mr. A. L. Doremus, head of the sales division of the Crocker-Wheeler Company, of which he is vice-president and secretary, spoke on the relation of advertising to sales. Mr. W. J. Marsden, of the Yale & Towne Manufacturing Company, made some remarks on export trade. As is usual at the monthly meetings of the association, several new members were elected.

N. E. L. A. OFFICES.—The National Electric Light Association, which for years past has occupied offices in the Electrical Exchange Building, 136 Liberty Street, New York City, has moved into the new Engineering Societies' Building, which will hereafter be the headquarters of the leading technical societies and bodies having headquarters in New York. Of late years the association has rapidly outgrown its old offices, and has therefore been prompt to avail itself of the splendid facilities presented in the new home for engineering provided through the generosity of Mr. Carnegie. It occupies four handsome and commodious rooms on the eighth floor of the building on West Thirty-ninth Street, with a fine lookout over Fifth Avenue, the East River and Long Island. With regard to light, air and sunshine the location leaves nothing to be desired. The suite consists of four rooms, namely, main office, secretary's office, board room and library and storeroom. The main office is 21 ft. 4 in. by 15 ft. 6 in.; the secretary's office is 21 ft. 4 in. by 14 ft. 10 in. and the library is 22 ft. 4 in. by 18 ft. 3 in. Each room is appropriately furnished for its specific functions and the association will henceforward enjoy accommodations worthy of its growing influence and prestige. Although the Engineering Building will not be formally dedicated before April, several societies are already occupying their new offices and the association is one of the first to take up its work under these improved and helpful conditions. The officers of the association have devoted no small amount of time and thought to the best arrangement of these offices, and it is believed that no society will find itself more comfortably and conveniently installed than the National Electric Light Association. The rooms are numbered 807, 808, 809 and 810.

TESTING WIRELESS.—It is stated from Berlin that the German cruiser *Vineta* has been ordered fitted with a wireless telegraph mast and will go to the Western Mediterranean, taking with her several experts to conduct a series of experiments. Efforts will be made on the *Vineta* when she reaches the Mediterranean to communicate with the wireless telegraph station at Nauen, near Berlin.

SMELTING BLACK SANDS.—The director of the United States Geological Survey in forwarding to Congress the special report of Dr. T. Day, C. E. Wilson and G. H. Clevenger, on the useful minerals in the black sands of the Pacific Coast and the application of electric smelting processes to them, has recommended an appropriation of $50,000 for the work of further study of this interesting and important subject.

THE KINGSTON EARTHQUAKE.—Cable service has been fully restored with Jamaica since the earthquake and the land telegraph and telephone lines are being put in order. President Hutcheson, of the West India Electric Company, which operates in Kingston, states that traffic earnings from the electric lines are only about $100 a day less than before the earthquake. All the rural and most of the city lines, he adds, are running as usual.

CALCINED MICA FOR INSULATION.—A United States patent was issued January 29, to Max Meirowsky, of Cologne-Ehrenfeld, Germany, covering a substitute for mica for commutator insulation. In order to render the insulation softer than the softest obtainable mica, the inventor employs hard mica calcined under pressure. The mica is pressed between two plates of suitable material which are placed in a calcining furnace. It is stated that the internal structure of the mica is so altered that it becomes equally as soft as the segments of a commutator.

CORPORATION REPORTS.—In the New York Legislature last week Mr. O'Brien, of Erie, introduced a measure which amends the franchise tax law. It was drawn by the city authorities of Buffalo, and provides that the annual reports to the Tax Commissioners shall, in addition to information heretofore required, include gross earnings, operating expenses, cost of permanent improvements, the net earnings, the assessed value of tangible property, capitalization at par, number of shares with par value and market value, and bonded indebtedness, as well as a statement of sums paid within the preceding year under any agreement based on percentage of gross earnings.

TO TRANSPORT MUSIC.—In the interest of the Cahill Telharmonium system, a bill was introduced last week in the New York Legislature by Senator Page providing for the application of the transportation corporation law to concerns interested in music telegraphy. The bill is one of the shortest on record. It says: "This article is made applicable to corporations for the generation and distribution of music electrically." Article VIII provides for the incorporation of telegraph and telephone corporations, the construction and extension of their lines, the transmission of their dispatches, consolidation of corporations and the appointment of special policemen.

COMPOSITE BRUSH FOR ELECTRICAL MACHINERY.—A United States patent issued January 29, to Hermann Viertel and Georg Egly, of Berlin, Germany, discloses a method of making high-conductivity brushes for electrical machinery. A mixture consisting of 75 parts of copper, 20 parts of tin and 5 parts of zinc in powdered form is thoroughly intermingled with ten per cent of graphite. The resultant mass is thoroughly kneaded with water, pressed in molds and then heated to about 600° C. in an hydrogenous atmosphere until softening and alloying of the metallic powders take place. It is stated that the conductivity of such bodies can be still more increased if they are subjected again to mechanical pressure after the metallic coalescence has taken place.

BOSTON WIRE INSPECTION.—A special dispatch from Boston of January 30 says: "The reasons for the opposition to Mayor Fitzgerald's bill to compel the fire insurance companies in this city to pay for the maintenance of the municipal wire department were disclosed to-day, when the bill reached the legislative insurance committee for a hearing. Assistant Corporation Counsel Spring appeared for the city of Boston and Osborne Howe, secretary of the Boston board of fire underwriters, for the insurance interests. Secretary Howe said that so far as the insurance companies are concerned, Mayor Fitzgerald may discontinue his wire department, for it merely duplicates the work that already is being done by the companies. They inspect the installation of all electric wires in the city and at the nominal expense to them of only about $5,000 a year, while the expenses of the municipal wire department are probably in the vicinity of $30,000 or $35,000 a year. Hence the companies do not regard the department as necessary and will oppose any plan to have such heavy expense for its maintenance saddled onto them."

EXPOSITION FOR LINCOLN, NEB.—Mr. T. B. Mitchell, manager of the commercial department of the Lincoln Gas & Electric Light Company, writes us that his company is preparing to give an exposition of applied gas and electricity in Lincoln, April 22 to 27, on a larger and more complete scale than has ever before been attempted in that vicinity. The company has secured the use of the Lincoln Auditorium, which will accommodate 4,000 people, and will have it piped and wired, so that manufacturers' exhibits can be easily installed and demonstrations easily made. While the company expects to make this exhibition of benefit to its business by creating a demand for the best of everything in gas and electric appliances, it is extending special invitation to officers of every gas and electric company in Nebraska and Kansas to come and bring their best customers to see the display and learn all they can. Manufacturers of gas and electric appliances are invited to make an exhibit during the week. All gas and current necessary will be furnished free by the Lincoln Gas & Electric Light Company and this company will also assist in the installation, so as to make the cost as low as possible. Floor space can be reserved by notifying Mr. Mitchell.

AMERICAN TELEPHONY.—A special cable dispatch of February 2 says: "The American telephone is cited as a model of perfection in a petition just sent to the president of the Chamber of Deputies by exasperated telephone subscribers in Paris. For some time past the service has been growing steadily worse, with the result that now in about nine cases out of ten it is impossible to get communication where formerly it was merely difficult. Finally the subscribers have risen and have petitioned Parliament to effect a radical reform in the telephone service and bring it up to the standard of perfection which has been obtained 'in all great nations in Europe and America.' This petition is signed by 25,000 telephone subscribers and by 7,200 members of a society formed to procure improvement in the telephone service in France. In the introduction to the petition Maitre Gerald, who was charged with the duty of drawing it up, lays stress upon the important part played by the telephone in modern life and says: 'In America it is regarded as one safeguard of public security,' and, discussing this, the preface says the telephone service is admirably organized in America. Maitre Gerard during a recent visit there found that communication is established invariably in a few seconds and the cost of subscription is so reasonable that no home is complete without one. The Figaro attributes this blissful condition to the fact that the State does not interfere with the service in any way. Consequently it is admirable."

Electrical Equipment of the West Virginia Pulp and Paper Company, Piedmont, W. Va.

IN the plant of the West Virginia Pulp and Paper Company at Piedmont. W. Va., electric power is now used exclusively, supplanting the steam equipment formerly used. At the time of conversion from steam to electric power there were employed about thirty-five steam engines, ranging in size from 75 to 700 hp, operating independently in various parts of the plant. In the construction of the present plant all the old engines were removed, the piping torn out, and the boiler plants dismantled. A new central boiler plant was in the meantime erected, cables laid and the conversion from steam to electric power made without interruption to service. The central power plant which is the only source of supply for the entire works, is located practically in the center of the group of buildings comprising the works and is admirably situated for an economical system of low tension distribution. In conformity with modern construction the building is fireproof and consists largely of concrete and steel.

The boiler plant, aggregating 7,200 boiler horse-power, consists of twelve Edgemoor units of the water tube type, operating at 150 lbs. pressure with all flues discharging into a single brick stack 235 ft. in height. A unique feature of the design is the installation of a Green economizer on the top of the setting of each boiler unit. The economizer scrapers for cleaning the boiler flues are operated by two 3-hp induction motors. The coal supply is delivered in cars on a trestle adjoining the boiler house and is dumped into a crusher geared to a 20-hp induction motor. From the crusher the coal is elevated by a bucket conveyor to a storage bin over the boiler room. From the bins the coal descends through chutes to Murphy automatic furnaces under the boilers. This conveyor is also used for carrying

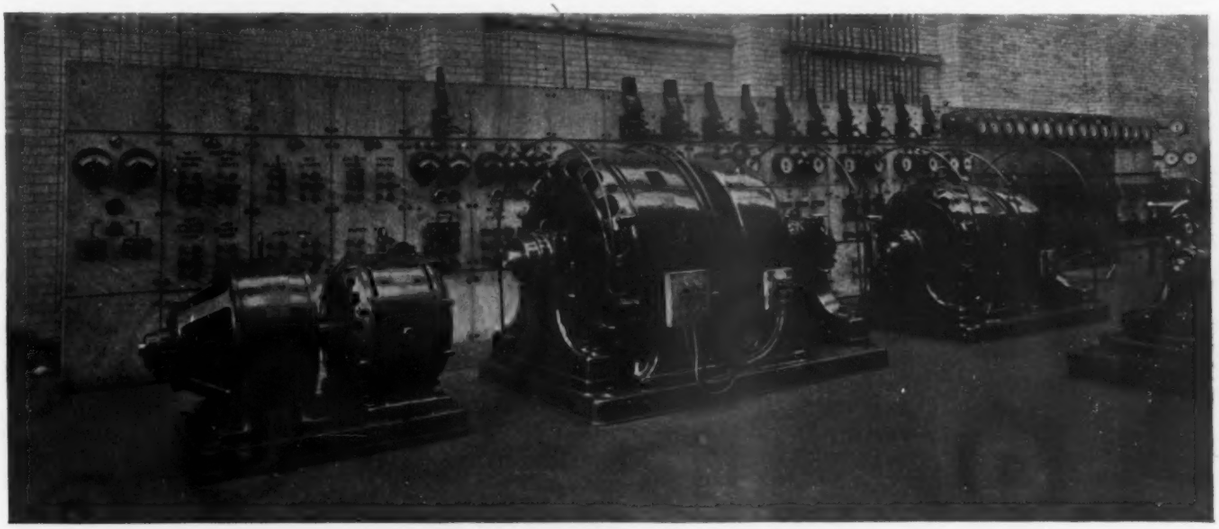


FIG. 1.—SWITCHBOARD AND MOTOR-GENERATOR SETS.

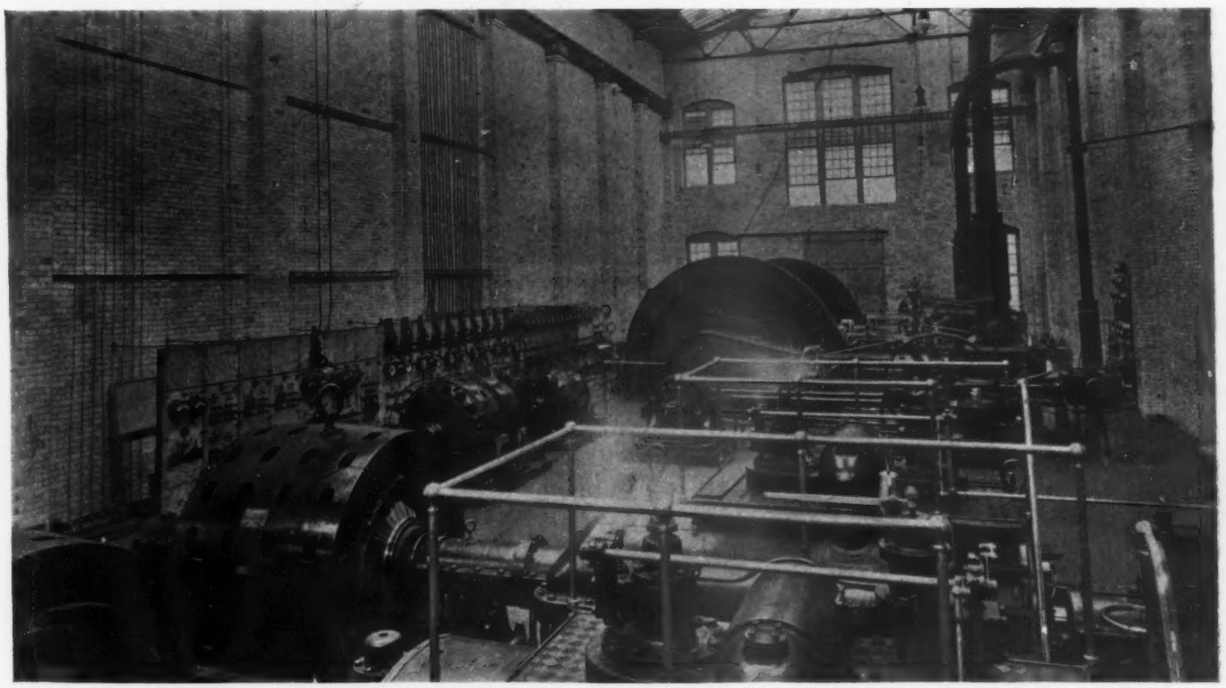


FIG. 2.—GENERAL VIEW OF GENERATOR ROOM.

ashes to an ash bin at the end of the coal bins where they can be loaded directly into cars by means of a chute. The conveyor is operated by a 15-hp induction motor.

A very attractive engine room has been secured by the use of white glazed brick on walls and pilasters and a wide expanse of wired glass in the roof, which, together with a liberal monitor occupies fully two-thirds of the roof area. The power house was originally laid out for horizontal cross-compound Corliss engine units, but the rapid increase in demands for power made it advantageous to employ steam turbines in order to avoid extending the present building as much as possible. Approximately one-half of the power plant is occupied by two 800-kw engine-driven units. The remaining half is now occupied by two 1,000-kw turbine units and a 1,200-kw unit in course of construction. Proportioning the power house for the

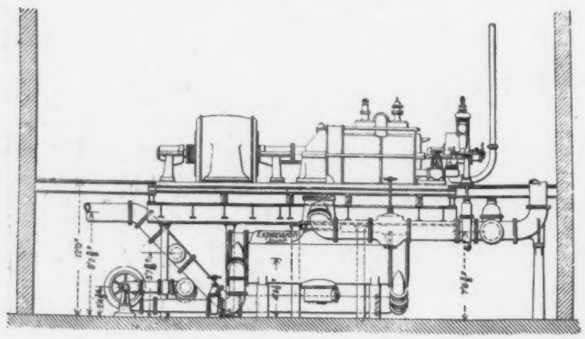


FIG. 3.—TURBINE AND CONDENSING PLANT.

engines and steam turbines the comparative floor space occupied is 5.25 and 1.53 sq. ft. per kilowatt for engine and turbine equipments respectively, including switchboard, condensers and auxiliaries.

Outside of the extraordinary compactness of the turbine unit itself the arrangement of the condensing system has contributed largely to the general compactness of the turbine plant. Each turbine has its own independent condenser outfit, which is located directly beneath it between the columns forming its foundation. This allows a spacing of 10 ft. 10 in. center to center, between the turbine units with ample working space both on the main floor and in the basement. The foundations consist simply of 8-in. cast iron columns with 20-in. I-beam

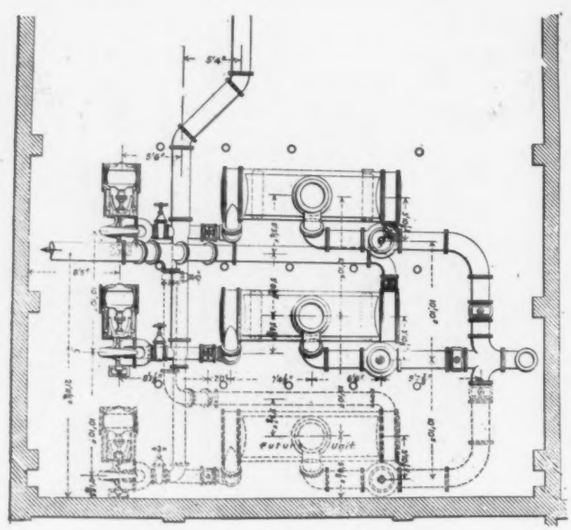


FIG. 4.—PLAN OF CONDENSING PLANT.

stringers beneath the bed plates and 15-in. cross-beams, the whole structure being thoroughly riveted and anchored to the general floor structure at the two ends. Each column foots on a steel grillage resting on hard pan. The necessary rigidity is further insured by the concrete arch floor construction.

The engine and generator equipment consists of two Hamilton-Corliss cross-compound engines each direct-connected to a revolving-field 440-volt, three-phase, 25-cycle generator operating at 94 r.p.m., two Westinghouse-Parsons turbo-generator units of 1,000 kw each, operating at 1,500 r.p.m., and one 1,200-kw turbo-generator unit in course of construction. The turbo-generators have the same characteristics as the engine-type machines. There are also three motor generator sets consisting of a 30-hp induction motor driving a 20-kw, 230-volt, direct-current generator operating at 720 r.p.m, for supplying current to cranes and hoists; a 150-hp induction motor driving a 100-kw, 125-volt, direct-current generator operating at 480 r.p.m., used as an exciter and for lighting purposes; an 85-hp induction motor driving a 56-kw, 125-volt, direct-current generator operated at 480 r.p.m. for lighting purposes and a 56¼-kw, 125-volt exciter driven by a Buckeye engine.

The switchboard is constructed of white marble, and consists of five alternator panels, one instrument panel, eight feeder panels, one motor starting panel, two direct-current generator panels, three lighting feeder panels and one crane feeder panel.

In the condensing plant two types of condensers are in use, the barometric type and the counter-current surface type. The former serves the reciprocating engine section of the power

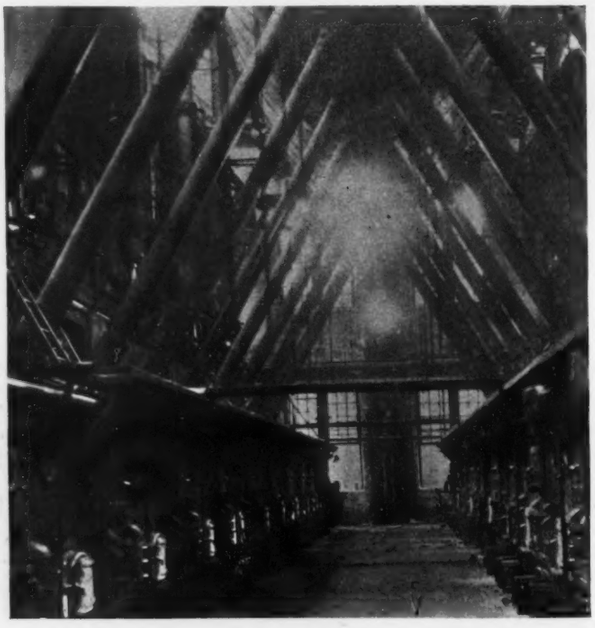


FIG. 5.—BOILER ROOM.

plant, and the latter the turbines. In order to secure the direct delivery of steam from the turbine exhaust to the condenser, the latter is of a form somewhat modified from the usual type built by the Alberger Condenser Company, although the fundamental counter-current principle is retained. Steam enters at the top of the condenser, while condensation is drawn from the hot well at the bottom, being finally delivered to a hot-water reservoir which receives other water returns. From this reservoir the boilers are partially supplied with feed water. Air is drawn from the condenser at about the middle of the shell corresponding to the second of the three water passes. A branch from the exhaust connection communicates with a free exhaust through a suitable relief valve.

Circulating water for both condensers is drawn from a concrete cold well supplied by gravity from a nearby river which has been dammed for this purpose. Motor-driven centrifugal pumps are used with both condensers. Entrained air is removed from the surface condensers by means of a duplicate set of rotative dry air pumps installed in a small addition to the power house together with two large fire pumps. The air pumps in addition to the usual duties are made use of while heating up the turbines preparatory to starting. A small injection line

is tapped into the water head of each condenser, and a supply of cold water drawn from the fire pump line for cooling the condenser until the turbine is ready to start. The main valve is then opened and the circulating pumps are thrown in. Each condenser pump is driven by a 30-hp induction motor. In freezing weather the power required for full load and high vacuum is, however, but little more than half the capacity of the motor or about 1.17 per cent of the power generated.

During normal operation the temperature of the discharge water is maintained at as nearly a definite degree as possible, as it is made use of in other parts of the plant. To accomplish this each pump is throttled by a gate valve so as to yield the highest temperature of discharge water and still maintain a high vacuum. With a temperature of 58° intake and a temperature of 108° at the discharge a vacuum of 27 to 27¼ in. is readily obtained at the elevation of Piedmont which corresponds to about 28 in. vacuum referred to a standard barometer.

The electric motor equipment comprises about sixty-five induction motors utilizing both belt and direct drive and operating from a three-phase, 440-volt system of distribution.

The various motor applications in the West Virginia Pulp and Paper Company's plant are best illustrated by a description of the process of making paper which will clearly show the many advantages gained by use of electric drive.

The pulp used by this company is known as soda pulp and is made from poplar, basswood, etc. The wood is received at the works in five-foot lengths and is generally well seasoned upon arrival at its destination. The logs are cut lengthwise to the desired size by a large rip saw driven by a 15-hp induction motor and then transferred to the chip house where are located two chipper wheels each operated by a 100-hp induction motor. These chipper wheels cut the wood into chips about ⅝ of an inch in length and revolve at the rate of 760 cuts per minute and have a capacity of about one hundred cords of wood every twenty-four hours. After the chips leave the chippers they are screened to remove the sawdust and dirt and are carried by a belt conveyor to the top of the chip house, then into a bin over the digester house where they flow by gravity to the digesters situated below.

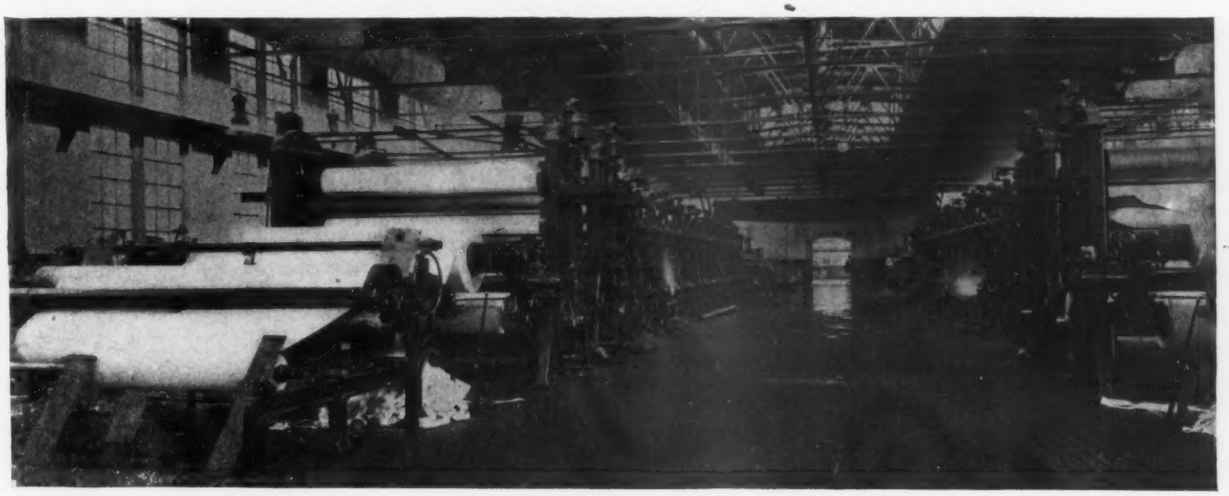


FIG. 6.—MOTOR-DRIVEN PAPER MACHINES.

An interesting test was made while the chipper was cutting poplar, the result being given below:

Highest reading, 158 hp; 23 hp, actual work performed.

Lowest reading, 19 hp; 3 hp actual work performed.

This shows the variable loads taken care of by the motor which maintains practically a constant speed under these wide fluctuations of horse-power. The overload capacity is also shown.

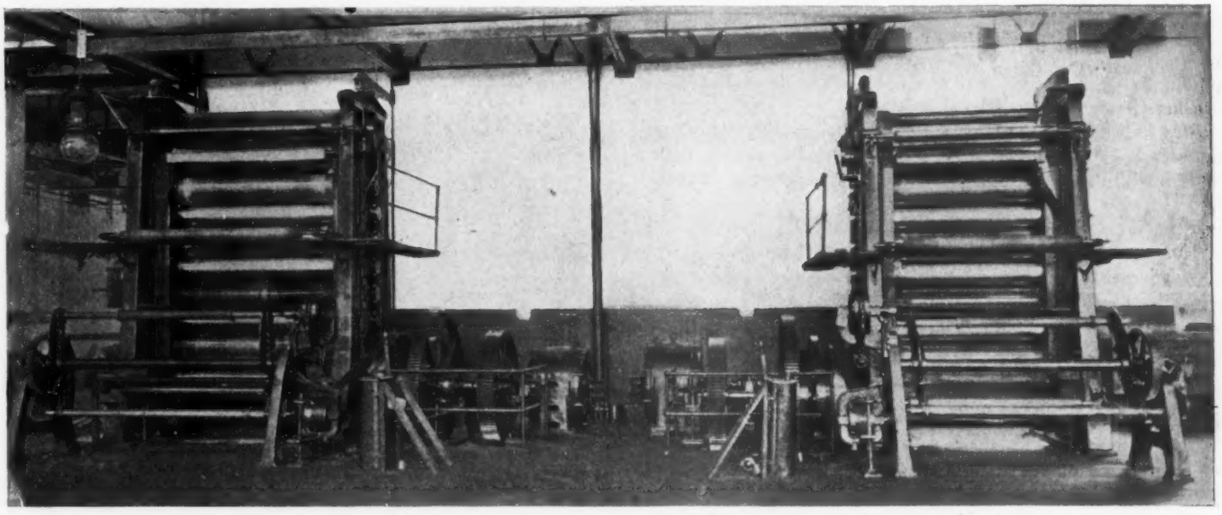


FIG. 7.—MOTOR-DRIVEN SUPER-CALENDER MACHINES.

Besides the two 100-hp motors in the chip house there is a 30-hp motor driving this chip conveyor and chip crusher and a 7½-hp motor operating a Robbins belt conveyor which delivers the chips to the storage bins over the digesters.

There are four digesters each 9 ft. in diameter and 42½ ft. in height with an approximate capacity of twelve cords of wood each. In the digesters the intercellular matter is dissolved by

cooking for a period of about eight hours with caustic soda under a steam pressure of 120 lbs. The material is transferred from the digesters into a pulp pit where the liquor is drained. After the pulp is cleaned of liquor by the draining process and washing, it is screened to remove all foreign substances and then bleached with a chloride of lime solution to prepare it for use in high grade paper. After bleaching, the pulp is again washed and screened, when it is ready for the manufacture of paper.

All liquor drained from the pulp is saved in order to regain

FIG. 8.—MOTORS OPERATING RECLAIMING ROTARIES, AGITATORS AND PUMPS.

the soda-ash contained in it. The liquor is evaporated first and the residue burned in rotary furnaces into an ash called black ash, consisting of carbon and sodium carbonate. It is then leached with hot water to dissolve the sodium carbonate, which is saved and used again in making the liquor in which the wood is boiled. The liquor itself is made by mixing carbonate of soda and water and caustizing with lime, the resultant liquor being known as caustic soda.

The foregoing process from the time the material leaves the digesters is carried on in departments known as the Wet Room, Bleaching Department and Bleaching Plant, which have the following equipments of motors:

Wet Room.—One 50-hp motor belted to centrifugal pumps; one 50-hp motor driving pumps and pulp crushers; one 30-hp motor driving screens; one 75-hp motor driving rotary furnaces, pumps and alkali mixers, and one 15-hp motor driving black ash crusher.

Bleaching Department.—One 100-hp motor driving pumps, agitators, and eleven bleach chests; one 50-hp motor driving pumps and bleach mixers, and one 50-hp motor driving pumps and agitators in chest.

Bleaching Plant.—Two 200-hp motors belted to direct-current generators which furnish current to electrolytic cells for the production of bleach carbonate of soda; one 50-hp motor driving pumps and agitators; one 10-hp motor driving exhaust fans, and one 10-hp motor that delivers carbon dioxide to electrolytic cells.

The bulk of the soda pulp used in this mill is pumped from the bleachers in the soda mill to the paper mills. Formerly all paper was made from rags, but pulp is now used exclusively in these works, of which there are two kinds—the variety known as soda pulp and the other known as sulphite fibre, which is made from spruce. The two pulps are brought together in the beating engine and mixed with clay, sizing and coloring matter. After leaving the beating engine, the stock is passed through refining engines in order to secure uniformity in the length of the fibre, etc. It then passes through the paper machines proper, after being screened to remove dirt and any small lumps that may be in the mixture. The stock flows on the paper machine with the appearance of skimmed milk, and passes on to an endless wire cloth which allows the water to escape by gravity. The fiber which remains on the wire is passed over suction boxes to still further remove the water, and is finally passed through a series of rolls to still further remove any moisture. It is then passed over the dryers which are cylinders heated by steam and from the dryers the treatment varies, according to the grade of paper required. Ordinarily the paper is passed through machine calenders, giving it a greater or less finish as may be desired. When an exceedingly high finish is required, the paper is passed through super-calenders consisting of alternate rolls of chilled iron and paper.

The following list gives the balance of the motor equipment together with the machines driven:

Pulp Mill, Machine Room.—One 40-hp motor driving pulp machines and pumps.

No. 7 Paper Mill, Beater Room.—Two 400-hp motors direct connected to line shafts, each of which drives four beaters and refining engines, and pumps for delivering stock to agitators and stock chest. The starting conditions imposed upon these motors are very severe, requiring a high starting torque; two 1-hp motors driving agitators and clay chest.

Machine Room.—Two 100-hp variable-speed motors direct connected to cone drive. Each of these motors drives the variable speed of the two paper machines, which are on the floor above; two 40-hp motors driving constant speed of two paper machines noted above. The constant-speed motors operate pumps, screens and shake. The variable-speed motors operate the wire press rolls, dryers and machine calenders. The weight of the paper is regulated by the change in speed of the machine and the flow of the stock.

Calender Room.—One 75-hp variable-speed motor geared to 72-in. stack of super-calenders. The slow speed of the calenders is driven by 15-hp motor by gearing; one 75-hp variable-speed motor driving 86-in. stack of super-calenders; one 15-hp motor operates slow speed by gearing; one ½-hp motor driving rewinder on above machine. The constant-speed motors are used for starting the calenders until the paper is threaded through the stack, at which time a variable-speed induction motor is thrown in and the constant-speed motor automatically thrown out of gear. The advantage of this drive is that the paper maker has several speeds for varying the stock, so that all bad places in the material may be discovered. One 75-hp variable-speed motor driving 66-in. stack of calenders; one 15-hp constant-speed induction motor operating at slow speed; one 50-hp variable-speed motor belted to line shaft and driving 36-in. stack of super-calenders. With this machine the slow speed is obtained by means of a friction clutch operating different sizes of gearing; one 75-hp variable-speed motor driving 86-in.

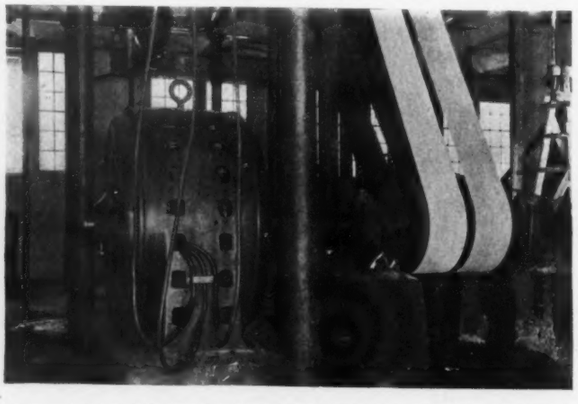


FIG. 9.—400-HP MOTOR OPERATING BEATERS AND REFINING ENGINES.

stack of super-calenders, with friction clutch on motor drive so that the motor runs continuously.

In the cutter room there is a 15-hp motor driving cutters and rewinders. Cutters cut the paper in large sheets of the required size and the rewinding machine rewinds the paper into rolls for shipment. In the carpenter shop there is a 10-hp motor driving a saw. In this shop cases and frames are made for shipment.

In the No. 7 mill the rolled paper is handled by electric

hoists and by traveling hoists in the calender room. In the finishing department where the paper is counted into reams and packed into either frames or cases for shipment, the bundles are handled by an electric traveling crane.

All the water used in the pulp and paper manufacture has to be filtered, which is accomplished by allowing the water to pass by gravity through sand filters. A 100-hp motor drives the centrifugal pumps which deliver water in the various parts of the mill to the agitators and filters.

The clay and sizing used in these mills is prepared at one point and delivered by piping to the different beater rooms. A 50-hp motor drives the clay mixer pumps, agitator and stock chest.

At No. 1 paper mill three 250-hp, slow-speed motors, are direct connected to a line shaft which is belted to beaters and refining engines. The starting conditions in this department are very severe, as it is about 900 ft. from the power house and the motors are started at full voltage. The motors have been operated for about four years under these conditions without difficulty. There are, in addition, two 75-hp motors driving paper machines; one 75-hp variable-speed motor driving a paper machine, and a 250-hp motor direct connected to a line shaft and driving by means of belts 7 stacks of super-calenders.

In No. 4 paper mill there are two 100-hp motors driving paper machines; one 400-hp motor belted to a line shaft which drives beaters and refining engines, and a 300-hp motor belted ters, and a 15-hp motor driving the carpenter shop.

In No. 4 millwright shop there is a 30-hp motor driving cutters, and a 15-hp motor driving carpenter shop.

There are four 30-hp motors direct connected to centrifugal condenser pumps in the power house, and a 100-hp, a 30-hp and a 40-hp motor are kept in reserve as spare units.

There are several motors used for construction work on new buildings, etc. They consist of two 15-hp motors operating concrete mixers; one 20-hp motor operating a stone crusher; one 10-hp motor operating a hoist for raising lumber for new building; one 15-hp, direct-current, 110-volt motor driving a roll grinder; one 2-hp, 110-volt, direct-current motor driving an air compressor and one 1-hp, 110-volt, direct-current motor driving a drill press.

A plant is now being erected at Piedmont to manufacture what is known as coated paper which has a high finish and is smoother than the best super-calendered paper. When coated paper is desired it is taken from the paper machines with a relatively low finish and is coated on one or both sides, as the case may be, with sizing and the best English China paper. It is

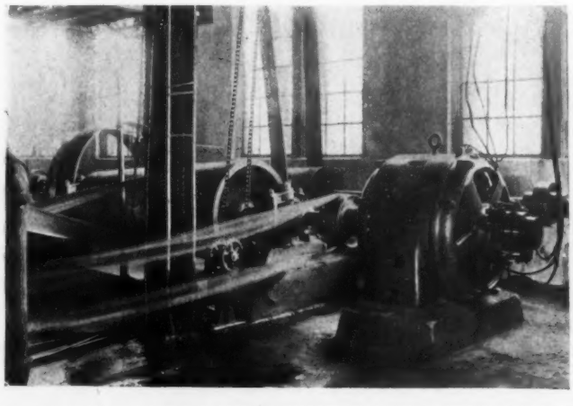


FIG. 10.—100-HP VARIABLE-SPEED MOTOR DRIVING PAPER MACHINERY.

afterwards dried by means of hot air and calendered to obtain a high glossy finish.

The new coating plant will consist of three buildings, each two stories high, with machine rooms 75 ft. wide by 432 ft. long. The super-calender and finishing rooms will each be 74 ft. wide by 119 ft. long.

All the machinery in the new plant will be electrically operated and an order for the following motors has been placed: One 75-hp constant-speed induction motor, one 30-hp constant-speed induction motor, and one 40-hp constant speed induction motor; two 50-hp variable-speed induction motors; five 75-hp variable-speed induction motors; seven 15-hp variable-speed induction motors, and three 10-hp variable-speed induction motors.

The West Virginia Pulp and Paper Company's plant at Piedmont, W. Va., is one of the most complete of its kind in the country, and at the present time has a force of about 800 em-

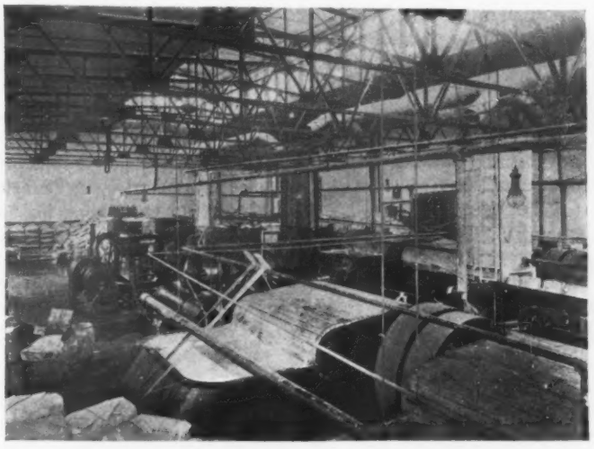


FIG. 11.—BEATER ROOM, SHOWING BEATERS AND REFINING ENGINES.

ployees. Credit for the design and layout of the works is due to Mr. F. G. Ten Broeck, consulting engineer, of New York City. Aside from the Piedmont plant this company operates mills at Tyrone, Pa., Davis, W. Va., Covington, Va., Mechanicville, N. Y., and Williamsburg, Pa., with a total daily capacity of 325 tons of paper and 385 tons of pulp. The entire generator and motor equipment was supplied by the Westinghouse Electric & Manufacturing Company.

Graphical Diagram for Determining the Reactance in Alternating Current Circuits.

By T. W. Varley.

THE familiar formula for determining the coefficient of inductance, L, of a complete single-phase circuit consisting of two wires, each 1 ft. in length, and r inches in radius spaced d inches apart is

$$L = \frac{28.07}{10^8} l \left(.1086 + log \frac{d}{r} \right) \qquad (1)$$

where L is expressed in henrys. This formula can be somewhat simplified by noting that .1086 is equal to log 1.285, so that the inductance coefficient becomes

$$L = \frac{28.07}{10^8} l \left(log\ 1.285 \frac{d}{r} \right) \qquad (2)$$

Since the reactance is equal to $2\pi f L$, the total reactance at 60 cycles of a 1,000-ft. circuit (2,000 ft. of wire), D inches in diameter may be expressed in ohms as

$$X_t = 0.106\ log \left(2.57 \frac{d}{D} \right) \qquad (3)$$

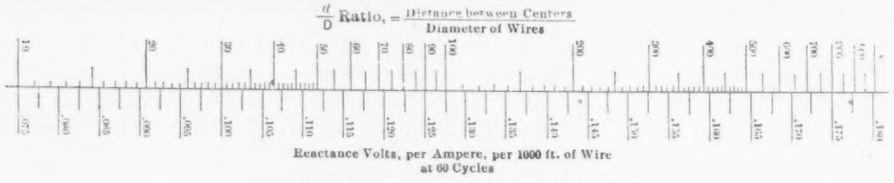
which value also represents the inductive reactance volts at one ampere. For reasons that will appear subsequently it is preferable to express the reactance in ohms per 1,000 ft. of single wire, so that the formula becomes

$$X = 0.053\ log \left(2.57 \frac{d}{D} \right) \qquad (4)$$

It is evident that by assuming certain values for the quantity $d \div D$ the corresponding values for X can be found by use of a table of logarithms. When these values are plotted to even-scale rectangular co-ordinates the well-known logarithmic curve is obtained; when they are plotted to rectangular co-ordinates with a logarithmic scale, the curve becomes a straight line. From either of these curves it is possible to determine the reactance volts per ampere for 1,000 ft. of wire for any size of wires and distance between them. It is believed that the accompanying diagram, which is equivalent to a straight line plotted from rectangular logarithmic co-ordinates, is preferable to such co-ordinate representation in that the values may be read, and approximated with a greater degree of accuracy and convenience.

As an example of the use of this diagram the following problem may be solved: What is the value of the reactance volts at 60 cycles of a single-phase circuit consisting of two No. 0 conductors spaced 12 in. apart? The conductor has a diameter of .3249 in., so that $d \div D = 37$; and the value for the reactance e.m.f., as found from the diagram, is about .1047 volts per 1,000 ft. of wire.

In the case of a three-phase circuit with the three wires placed at the apex of an equilateral triangle, and the currents differing in phase by 120 electrical time degrees, each wire can be considered as having a single return wire (in the two other conductors) spaced from it a distance equal to one side of the triangle. Thus the reactance volts per single wire is the same



LOGARITHMIC DIAGRAM OF REACTANCE VOLTAGE.

per ampere in the wire whether the wire forms a part of a single-phase circuit or of a three-phase circuit. Therefore, the diagram can be used at once for determining the reactance in three-phase circuits.

Let it be required to find the reactance volts in each wire of a three-phase system delivering 10,000 kw 5,000 ft. at 10,000 volts between 500,000-cir.-mil wires spaced 48 in. apart. The diameter of the conductor is .708 in., so that $d \div D = 68$; the value of the reactance volts as found from the diagram is .119 ohm in each wire per ampere per 1,000 ft. of circuit. The current per wire is

$$I = \frac{W}{\sqrt{3}\,E} = \frac{10{,}000{,}000}{\sqrt{3}\ 10{,}000} = 577 \text{ amperes,}$$

so that the reactance e.m.f. for 5,000 ft. of wire will be $.119 \times 577 \times 5 = 343$ **volts in each wire.**

For convenience, the accompanying table is given to show the relative diameters of commercial sizes of transmission wire.

Size of wire — cir. mils.	Size of wire — B & S gauge.	Diameter inch.	Ratio $d \div D$ for 12 in.
2,000,000	—	1.414	8.5
1,750,000	—	1.321	9.1
1,500,000	—	1.224	9.8
1,000,000	—	1.000	12.
750,000	—	.866	13.86
500,000	—	.708	17.
250,000	—	.500	24.
211,600	0000	.460	26.1
167,800	000	.4096	29.35
135,100	00	.3648	32.95
105,500	0	.3249	37.
83,690	1	.2893	41.55
66,370	2	.2576	46.6
52,630	3	.2294	52.4
41,740	4	.2043	58.7
33,100	5	.1819	66.05
26,250	6	.1620	74.2
20,820	7	.1443	83.2
16,520	8	.1285	93.5

The fourth volumn gives the value of $d \div D$ for 12 in. between the wires. For other distances this ratio should be multiplied by the distance between wires in feet. The new value then allows the reactance volts per ampere per 1,000 ft. of single wire to be ascertained at once from the diagram. The diagram is based on 60 cycles; for other frequencies the reactance and reactance volts are evidently proportional directly to the frequency. Since there is no effective mutual induction between the two separate circuits of a two-phase system, each circuit can be treated as a single-phase system, and the reactance volts can be determined at once from the accompanying table and diagram.

Three-Phase Transformation.

By A. S. McAllister.

A STUDY of the fluxes demanded by three sinusoidal electromotive forces displaced from each other by 120 electrical time degrees will show that at any chosen instant the sum of any two of the fluxes is equal in value and opposite in direction to the remaining flux. The significance of this result is that if a transformer core be constructed with three legs, each wound with the same number of turns, and if the three windings be subjected to electromotive forces in true three-phase relation to each other, each coil and core will operate exactly like the primary winding and magnetic circuit of a separate single-phase transformer. In consequence of this fact by increasing the material of a core-type single-phase transformer by slightly more than fifty per cent, the rating of the equipment becomes exactly fifty per cent greater, as a three-phase transformer. Thus by adding a little over fifty per cent to the material of a 10-kw core-type transformer there is obtained a three-phase transformer whose rating is 15 kw. Such a polyphase transformer is capable of performing the work of three 5-kw single-phase transformers Δ-connected or Y-connected, or of two 8.66-kw transformers V-connected, or of one 7.5-kw and one 8.66-kw transformers T-connected.

The relative merits of the three-phase transformer and the combination of single-phase transformers that may be employed for obtaining the same service are frequently discussed on the basis of the decrease in cost of the several types of transformers with increase in rating, and on such basis it has been shown that the three-phase transformer is the cheapest,

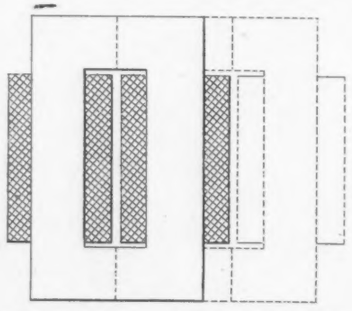


FIG. I.—ACTIVE MATERIAL FOR SINGLE-PHASE AND THREE-PHASE TRANSFORMERS.

because it represents in its construction 150 per cent of the cost of a 10-kw transformer, while the other combinations are more expensive on account of requiring an equal or greater aggregate rating in smaller transformers. The outline discussion given below is intended to show that, quite apart from the decrease in manufacturing cost with increase in size of transformer units, the three-phase transformer possesses a real advantage in requiring less material and being more efficient than other transformer combinations, and that the advantage in this one respect is quite appreciable even when the three-phase transformer

is of large capacity. Mention is also made of the advantages of the T-connection of two transformers when a three-phase transformer cannot be obtained.

Referring now to Fig. 1, which indicates the relative increase in constructive material required for changing a single-phase to a three-phase transformer having a 50 per cent larger rating, it will be noted that 50 per cent more copper must be used and that the iron must be increased by slightly more than 50 per cent. As an average value it may be stated that the weight of iron per kw rating will be about 6 per cent greater than, and the weight of copper exactly the same as, that for a single-phase transformer having 66⅔ per cent as large a rating. Using values obtained from a certain commercial line of single-phase core-type transformers, as published in the bulletins of the manufacturer, it is found that the copper of a 10-kw transformer weighs 17.3 lbs. per kw and the iron weighs 22 lbs. per kw, while the corresponding values for a 5-kw transformer are 23.6 lbs. of copper and 25.6 lbs. of iron. Thus a 15-kw three-phase transformer requires 17.3 lbs. of copper and 23.3 lbs. of iron per kw, while three 5-kw single-phase transformers require 23.6 lbs. of copper and 25.6 lbs. of iron per kw. Moreover, the copper loss in the three-phase transformer at full load is 17.7 watts and the iron loss 11.2 watts per kw while the corresponding losses for the three single-phase transformers are 20.0 and 12.2, respectively. Thus the full-load efficiency of the

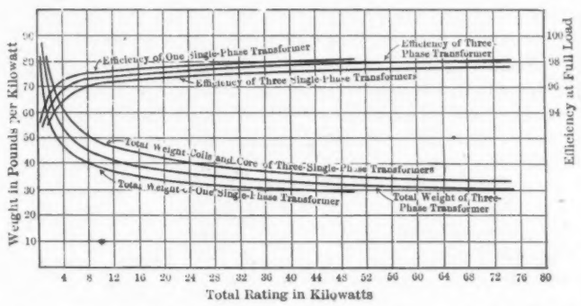

Efficiency of One Single-Phase Transformer
Efficiency of Three Phase Transformer
Efficiency of Three Single-Phase Transformers
Total Weight Coils and Core of Three Single-Phase Transformers
Total Weight of One Single-Phase Transformer
Total Weight of Three-Phase Transformer
Weight in Pounds per Kilowatt
Efficiency at Full Load
Total Rating in Kilowatts

FIG. 2.—COMPARISON OF TRANSFORMER EQUIPMENTS GIVING THE SAME TOTAL OUTPUT.

three-phase transformer is 97.2 per cent and, of the three-single-phase transformers 96.9 per cent.

The results of a series of calculations similar to the above covering the complete line of transformers ranging in capacity from .75 to 75 kilowatts are indicated graphically in Fig. 2, where smooth curves have been drawn through more or less irregularly placed points. It will be seen at a glance that for each value of power to be transformed, the three-phase transformer requires less constructive material and is more efficient than three single-phase transformers having the same combined rating. It is to be noted, however, that a single single-phase transformer of the same total rating requires much less material and is more efficient than the three-phase transformer unit.

The above facts deal with the fundamental phenomena involved in the design of transformers, and they are independent of the decrease in manufacturing cost with the increase in size of transformer units. The last mentioned decrease serves, moreover, to emphasize the relative advantages of the three-phase transformer; it is, however, more pronounced the smaller the units, because the cost approximates a constant value per lb. of material for extremely large transformers, but approaches more nearly a constant value per transformer units in very small sizes.

Although in selecting the material and determining the dimensions of any certain line of transformers the designer arranges each unit as a compromise between the demands of lightness and efficiency, quite independent of the other units of the same line, the fact remains that the best compromise for each unit is so related to that for the other units that there results a definite rate of decrease of loss, or of weight, per kw with increase in capacity of the transformers of each line. A study of numerous lines of single-phase transformers as manufactured at the present time shows that the loss in watts per kilowatt in any certain line of transformers may be expressed, with an error that is quite small by the following equation:

$$L = \frac{k}{W^x}$$

where W is the rating of the transformer in any chosen unit, k is the loss in watts per kilowatt for a transformer rated at one unit, and x is an exponent the value of which varies slightly with the rating but is practically constant over a large range. It has been found that for almost all lines of transformers, including core-type and shell-type, high-voltage and low-voltage, high-frequency and low-frequency, air-blast, self-cooling and water cooled, x has a value seldom much greater or less than .26; it is larger at low ratings and also at very high electromotive forces. The significance of this result is that the loss in a 3-kw transformer is ¾ as large per kw as that in a 1-kw transformer of the same line; the loss per kw in a 30-kw transformer equals 75. per cent of that in a 10-kw transformer, a 300-kw transformer has a loss per kw three-fourths of that of a 100-kw transformer, and a 3,000-kw transformer suffers a loss of 75. per cent as large per kw as that of a 1,000-kw transformer, and so on. It is worthy of note that of the numerous lines of transformers examined, the one upon which the calculations indicated in Fig. 2 were based showed the most marked disagreement with the above equation. The divergence was such as to be unfavorable to the three-phase transformer; hence the comparison to be drawn from Fig. 2 in no respect exaggerates the advantages of the three-phase transformer.

Although in any certain line of transformers the core loss per lb. of iron and the coil loss per lb. of copper do not vary appreciably throughout a limited range in rating (that is, the magnetic and current densities are constant); yet the ratio of iron to copper changes somewhat with the size of the transformer. Thus two transformers having exactly the same loss per lb. of iron and per lb. of copper, and the same total loss per kilowatt, may not weigh the same per kilowatt; moreover, the constructive material may not cost the same per kw of rating or per lb. of total weight. However, throughout a limited range it may fairly be stated that the weight of transformers in a certain line varies directly with the losses. The maximum adverse divergence for all lines examined was found to be in the line selected for the comparison in Fig. 2. If the relations here deduced were absolutely correct for all sizes of transformers, the following conclusions could be drawn—minor disturbing effects being ignored:

A single-phase transformer weighs 25 per cent less than three separate transformers having the same total rating; its losses at full load are also 25 per cent less. A three-phase transformer weighs 16.5 per cent less than three separate transformers; its losses are also 16.5 per cent less. Two transformers V-connected weigh exactly the same as three separate single-phase transformers for the same power transmitted; the losses are also equal. Two transformers T-connected have a combined weight 5 per cent less than three separate transformers either Δ-connected or Y-connected or than two transformers V-connected; the losses are likewise 5 per cent less. It is believed that the comparisons here made are fair in every respect to each type of transformer or interconnection of transformers.

From the above considerations it would seem that for the transformation of three-phase power the three-phase transformer is to be preferred to any other possible equipment. So far as concerns the cost of the equipment and the efficiency in operation two T-connected transformers are preferable either to two V-connected transformers or to three transformers Δ-connected or Y-connected.

In comparing the T-connection with the Δ or Y-connection, it is to be noted that each connection accomplishes the transformation without sensible distortion of phase relations. The T-connection allows the neutral point to be reached equally as

well as does the Y-connection. The Δ-connection, however, is the only one capable of transforming in emergencies with one disabled transformer.

With reference to its ability to maintain balanced phase relations, the T-connection is much better than the V-connection. For the starting of three-phase motors at reduced voltages, where the transformers are in use for only a small fraction of the total time, the distortion of phase relations may not be serious; but, for continuous operation the distortion should not be permitted. For the latter condition the T-connection is preferable in every respect to the V-connection, and in many cases it should prove more advantageous than either the Δ or the Y-connection of three separate transformers.

It is worthy of note that the prime requisite for the T-connection of the transformers for three-phase work is met when the two transformers possess the same ratio of primary to secondary turns and a tap is brought out from the central point of one of the transformers; the two halves of both the primary and the secondary windings of the latter transformer should be well interspaced to prevent excessive magnetic leakage. It is not essential that the former transformer be designed for exactly 86.6 per cent of the voltage of the latter; the normal voltage of one can be 90 per cent of the other, without producing detrimental results. Moreover, transformers designed for the same normal e.m.f. and intended for V-connection can be T-connected with considerable improvement in service.

English Electrical Law in 1906.

By A. Britton.

In the course of a case which was recently heard in the English Privy Council on appeal from one of the Canadian courts, one of the counsel engaged cited a decision of the United States Supreme Court. It turned out that the decision was one which related to the American Constitution; and that it was not, therefore, germane to the point under discussion, but Lord Halsbury (the ex-Lord Chancellor) pointed out that the decision of the highest court in the United States was entitled to the greatest respect in English courts of justice.

Upon the assumption—which is made with some confidence—that the converse, namely, that American judges give weight to the opinion of their English compeers, a short survey of some of the cases relating to electricity which have been decided during 1906 may be of service to American electrical engineers. It is true that the law relating to electricity is in both countries set forth in the statute books; in England the general law is contained in certain public acts of Parliament, while the particular rights and duties of local authorities and companies supplying electricity are set forth in what are known as private acts. In America, too, it is apprehended that the law of electricity in any particular State of the Union is to be found in its statute book. Nevertheless when we come to consider general principles, it is found that those which are applied in the United States are founded on those which obtain in the courts of the mother country.

There have not been many cases during the past year dealing specifically with electricity. It is proposed, however, to summarize those which are most likely to be of interest to American electrical engineers.

The question of nuisance caused by electrical undertakers has been considered within the last few months. Some of the residents in a street adjoining the electricity works of London Borough Council brought an action to restrain the council from continuing a nuisance caused by their dust destructor and electricity works; and, while the residents lost their case so far as the dust destructor was concerned, they succeeded in obtaining an injunction restraining the defendants from working their engines so as to cause vibration sufficient to constitute a "legal nuisance."

The trouble in question was caused by a three-crank compound engine, driving a 450-kw continuous-current dynamo, which had been the cause of complaint in a former action. Since then, however, the balancing of the engine had been improved by carrying out certain recommendations of Professor Dalby, but recently the set had needed repairs, and, after it had been taken down and re-erected, the vibration was once more evident. It was practically admitted by the defendants that there had been a certain amount of vibration when this particular engine was running. The serious matter for consideration is the effect of such decisions in hampering the development of the electricity supply industry, which is already crippled by a number of legal restrictions. The following clause is included in every electric lighting order: "Nothing in this order shall exonerate the undertakers from any indictment, action or other proceedings for nuisance in the event of any nuisance being caused by them." Thus, although the electricity supply undertaker is bound under penalty to supply electricity to practically every consumer who requires it, and must, therefore, gradually increase the size of his works and put in larger generating units, yet he is liable to an injunction at any time calling upon him to stop these engines if it can be proved that they cause sufficient vibration to be objectionable to those living near the works. For if a 450-kw set, even though it be a badly balanced reciprocating engine, creates an "actionable nuisance," the sets of twice, thrice or ten times the size, now being installed in electricity works, may well do the same, for presumably noise is a nuisance just as much as slower vibrations; and the large turbine sets that are now built do not always run silently. A simple remedy for this state of affairs would be, of course, for the electricity supply authorities to buy the property surrounding the works; but, unfortunately, the undertaker has no powers of compulsory purchase under the electric lighting acts. As a matter of fact, the Borough Council in the former case alluded to had already acquired the land on which the houses stood, but not the leases, and one result of the action was that the council finally bought the leases at a far higher price than they would otherwise have had to pay. It may be mentioned, with reference to this case, that the Borough Council have recently introduced a bill into Parliament with a view to relieving themselves of this clause.

In England, as in the United States, a conflict rages between local bodies and private companies in relation to the right to supply electricity. That right, according to some people, should be confined to municipal enterprise; and the English electric lighting acts are so drafted that after the lapse of a number of years the local authority in any district may acquire compulsorily all the undertaking of a private company. In the meantime, however, there are facilities for the friendly transfer of an undertaking from a local authority to a private company and vice versa.

Agreements for the transfer of electrical undertakings must be sanctioned by the Board of Trade, and the question has recently arisen as to what agreement must be sanctioned. It appears from the case of Mayor of Lambeth vs. South London Electric Supply Corporation, that all the terms of the arrangement must be brought before the board. By a provisional order, confirmed by statute, local authorities were made the undertakers for the supply of electrical energy for lighting purposes within their district, and they were enabled with the approval of the Board of Trade to transfer their powers. The local authorities entered into negotiations with a company for the transfer to the latter of their powers, and it was agreed that the company, as a term of the transfer, should erect and maintain a dust destructor and dispose of the refuse supplied to them by the local authority. A deed containing these terms was submitted to the Board of Trade, but the board refused to approve of it upon the ground that they had nothing to do with the erection of a dust destructor. Two deeds were then drawn up, the first for the transfer of the powers of the local authority as to electric lighting, which the Board of Trade approved, and the second for the erection and maintenance by the company of a dust destructor. The destructor having been erected, the company refused to maintain it and to dispose of the refuse. In an action by the local authorities for a declaration of their rights,

it was held that, as the execution of the second deed relating to the dust destructor was a term of the first deed, it required the approval of the Board of Trade, and without that approval it was invalid.

The question of compulsory purchase has also arisen in relation to electric tramways. Just as, under the electric lighting acts, the undertaking of a company may be bought up by the local authority at some time or other on the terms of the local authority paying the "then value" of the undertaking, so under Section 43 of the Tramways Act, 1870, a tramway company may have to transfer its property and good will. The question, What constitutes the "then value" has given rise to some difficulty in practice. It would seem to mean the value to the sellers, not the value to the buyers. It was decided by the House of Lords in the recent case of Manchester Carriage & Tramway Company vs. Swinton & Pendlebury U. D. C. (22 T. L. R., 154) that where local authorities purchase the undertaking of a tramway company under Section 43 of the Tramways Act, 1870, they may be compelled to purchase a depot outside their district which is suitable to and used by the tramway company for the purposes of its undertaking within the district. "The then value" of the tramway, etc., in Section 43, means the value to the promoters, and not the value to the purchasing authority at the date of the notice requiring the tramway company to sell. The decision of the Court of Appeals reversed and the judgment of Channell, J., restored, upon the ground that the finding of the arbitrator in the special case was not ambiguous, and that he had found that the depot was suitable to and used for the purposes of the undertaking. The effect of this decision may be illustrated by considering the position of an electric lighting company selling its undertaking to a local authority who desired to "scrap" the old plant, and substitute new therefor. In such a case the "then value" would not be the value of old iron, but the value which the plant was to the vendors.

While local authorities in their position as undertakers for the supply of electricity have many privileges, they are by no means all powerful; and are not permitted to exceed the rights and privileges conferred upon them by statute. So, where land is purchased by agreement for the purpose of erecting a generating station, the building of a refuse destructor thereon will be prohibited by the court. In Attorney-General vs. Pontypridd Urban District Council (22 T. L. R., 576) local authorities, who were the undertakers for the supply of electricity within their district, purchased by agreement land for the erection thereon of an electric generating station. The whole of the land not being wanted for the generating station, they proceeded to erect a refuse destructor on part of the land, intending to utilize the heat derived from the refuse destructor in the generation of electrical energy. At the time they purchased the land they intended so to use it, but this was not communicated to the vendor. It was held that the local authorities were not entitled to use the land, which was acquired for the purpose of erecting a generating station, for the erection of a refuse destructor, which was no part of the generating station, nor necessary and incidental to the supply of electricity, and that an injunction would be granted to restrain them from doing so.

In England as in America, an electric tramway company which acquires the right to run trams along streets (in America the right is termed a franchise) must fulfil certain obligations to the public. Thus the highway authority are generally relieved from the duty of maintaining or repairing that part of the road which is occupied by the track; this work being handed over entirely to the tramway company, where disputes arise as to the construction of the clause which imposes this obligation, they are in general referred to arbitration, and it has recently been decided under a local act that disputes relating to the question as to who is to repair the junction between tramway track and road metal must also be referred by Section 57, subs. 5, of the Norwich Electric Tramways Act, 1897, "if the company fail to maintain and keep in good condition to the satisfaction of the corporation. . . . (5) The junction of the paving laid and maintained by the company with the surface laid and maintained by the corporation," the corporation may do the work necessary for the repair and maintenance of the road, and the expense reasonably incurred by the corporation in so doing shall be repaid to them by the company. A dispute having arisen between the corporation and the tramway company as to keeping in good repair and at a proper level the junction of the paving laid by the company with that laid by the corporation, it was held that the dispute must be referred to an arbitrator nominated by the Board of Trade, under Section 33 of the Tramways Act, 1870, and that the court had no jurisdiction to entertain an action in respect of it. (Mayor, etc., of Norwich, vs. Norwich Electric Tramways Company, 22 T. L. R., 553.)

One other case, which relates to the "hiring" of a supply of power, remains to be noted. The defendants, who were the lessees of a factory, demised to the plaintiffs a room therein and agreed to supply to them power from an engine for working a machine in the room demised at a yearly rent of £100. The engine was under the control and in the possession of the defendants. While the engine was working the machine, owing to a defect in the governor it went too fast, with the result that part of the machine in the plaintiff's room became heated and broke, and killed a workman employed by the plaintiffs. The plaintiffs, having paid the widow compensation under the Workmen's Compensation Act, 1897, sued the defendants to recover the amount so paid. The jury found that the defendants had not supplied power which was reasonably fit for the purpose of working the machine. It was held that apart from the demise of the room there was a contract by the defendants to supply to the plaintiffs power for working the machine; that this was a contract of purchase and sale; that there was, therefore, an obligation to supply power reasonably fit for the purpose; and that the plaintiffs were entitled to recover. (Bentley Brothers vs. A. Metcalfe & Co., 22 T. L. R., 676.)

Generating Station of the Mount Union Light & Power Company of Mount Union, Pa.

The town of Mount Union is on the main line of the Middle Division of the Pennsylvania Railroad, 86 miles west of Harrisburg and and in the center of the extensive improvements being made by the above mentioned railroad. It has a population of about 3,000 people and is growing rapidly.

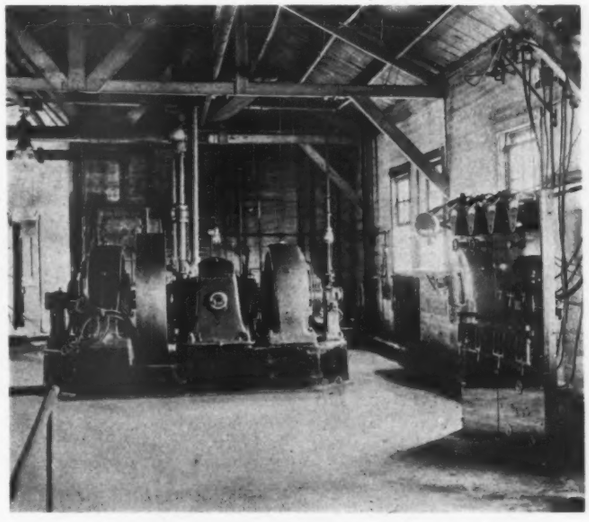


FIG. 1.—GENERAL VIEW OF INTERIOR OF GENERATING STATION.

The plant of the Mount Union Light & Power Company was built in April, 1905; it is situated in the eastern part of the town and is adjacent to the fire brick factory of the Mount Union Silica Brick Company.

The boiler room contains three Erie City return tubular boilers, two of 150 hp each and one of 250 hp; these boilers are fired

with Rock Ridge bituminous coal costing $1.95 per ton delivered. The furnaces are hand-fired and the water supply is secured from a small stream near the plant; two Worthington feed-water pumps are used to supply the boilers through a Cochran special feed-water heater.

The engine and generator equipment consists of one Ball engine driving two 50-kw, 120-volt General Electric generators, operated on a three-wire system. The switchboard is of the General Electric make and consists of two panels, one generator panel and one circuit panel.

The notable feature of this installation is the street-lighting system, which consists of 33 enclosed Adams-Bagnall arc lamps, connected in multiple on two circuits, there are also five 50-cp incandescents on the streets. The street system burns until

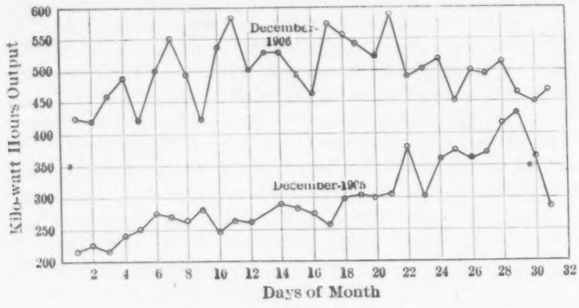


FIG. 2.—INCREASE IN OUTPUT FOR DECEMBER, 1906.

12 m., and the company receives $48 per year for each arc lamp and $15 per year for each incandescent lamp.

The company has a connected load of about 2,000 16-cp incandescent lamps, on the meter system, the rate being 10 cents per kw-hour. Incandescent lamps are renewed at the rate of 20 cents each. The office of the company is in the central part of the town, where a show room is maintained.

To give an idea of the increase of business during 1906 Fig 2 is presented; this tells at a glance the increase in output for December, 1906, over December, 1905. Scott Dibert is owner of the plant and John L. Dickson is the superintendent.

Prevention of Sparking in Alternating-Current Commutator Motors.

Four patents were issued to Mr. Marius Latour on January 15 on various schemes for the prevention of sparking in alternating-current commutator motors. Three of the patents relate to the use of a plurality of parallel armature windings connected to successive commutator segments, the width of each brush being insufficient to bridge two commutator segments that are

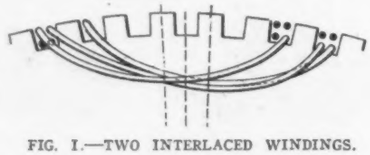


FIG. 1.—TWO INTERLACED WINDINGS.

connected to the same winding. The novel features reside in so arranging the coils of the separate windings as to obtain an even progression of the voltages in the several coils without increasing the number of slots. In the scheme shown in Fig. 1 there are two windings, one of which consists of coils having a width greater by one slot than the coil width of the other winding. The scheme illustrated in Fig. 2, which is applicable to two or more interlaced windings, consists in connecting the commutator leads of one or more of the windings to intermediate points on the coils of the windings, so that the portion of that winding included between two adjacent commutator leads comprises portions of two different coils in two adjacent sets of slots. According to a third method, as illustrated in Fig. 3, four windings of only two turns per coil are arranged so as to give the desired progression of phase at the commutator; the conductors forming one side of a coil are arranged

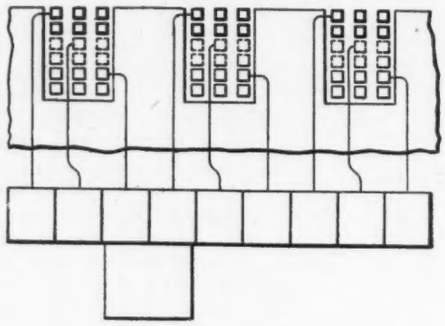


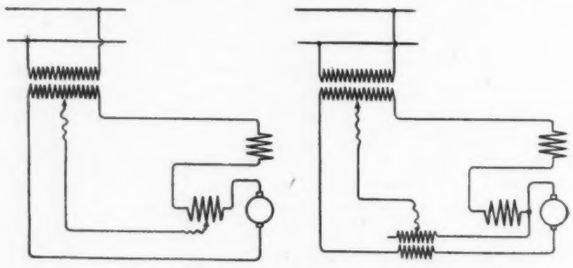
FIG. 2.—THREE INTERLACED WINDINGS.

in a single slot, while the other side of the coil is distributed in two slots.

Figs. 4 and 5 illustrate a scheme for improving the commu-

FIG. 3.—FOUR INTERLACED WINDINGS.

tation by superposing upon the field magnetism a certain component of flux which tends to produce a commutating field in the armature and thus to render it possible to run the motor at



FIGS. 4 AND 5.—METHOD OF IMPROVING COMMUTATION.

speeds greatly above synchronism. The voltage impressed upon the field coils is made to depend upon the current in the armature, and it is stated that a commutating field of the proper phase and amount may thus be obtained for enabling the motor to operate sparklessly at any given speed within limits.

Recent Electrochemical Developments.

ELECTRIC FURNACES.

At the Ithaca meeting of the American Electrochemical Society Mr. C. L. Collens, Second, presented a highly mathematical paper on the theory of electric resistance furnaces in which the material to be treated is heated from a resistor through which the electric current passes. From this resistor (for instance, the carbon rod in the center of a carborundum furnace) the heat passes outward into the material under treatment (the mixture of sand, coke and sawdust from which the carborundum is to be produced). The temperature is highest right at the resistor and decreases with increasing distance from the resistor. Now the desired furnace reaction will go on only between certain limits of temperature. Hence the desired product will be formed in the furnace in a certain zone only, which is enclosed by two isothermal surfaces; the one near the resistor has the maximum temperature at which the product is formed, the other further away has the minimum temperature.

The heat which comes from the resistor enters the zone of reaction through the first (maximum temperature) isothermal surface, flows through the zone of reaction and leaves it through

the second (minimum temperature) isothermal surface. The first surface is called by Mr. Collens the "surface of productive heat diffusion," because the heat passing through it is utilized to form the desired product. The second surface is called by him the "surface of non-productive heat diffusion" because the heat passing through it out of the zone of the reaction is wasted. One of the chief results of Mr. Collens' mathematical discussion was the proof that the ratio which the surface of productive heat diffusion bears to the surface of non-productive heat diffusion should be made as large as possible. The reasons are obvious even without mathematics. A very large surface of productive heat diffusion means that a large proportion of the entire mass is in contact with the heat-generating body. This facilitates the diffusion of heat in the productive zone of reaction and tends to maintain within that zone the state of steady flow of heat. With a high energy supply a given amount of thermal work can be done in a very short time during which only a very small amount of heat will be diffused into the materials beyond. Summed up in a few words, a relatively large surface of productive heat diffusion means high efficiency without increased labor cost.

We have dwelled at some length on this principle because it has been actually followed in resistance furnace design. Some examples of its application in Niagara practice are given in Mr. Collens' paper, above referred to. This principle is carried through with consequence in a new furnace construction recently patented by Mr. Collens. Between the two terminals at the two ends of the furnace there are alternately thin vertical columns of the powdered resistor material and tiers of blocks of the material under treatment. Thin carbon or graphite slabs are placed between these blocks to make electrical connection between two successive columns of the resistor material. A very large contact surface between resistor material and material under treatment is evidently produced in this way, as desired.

For many purposes, for instance in dental practice, a resistance furnace is used in which the heat is produced in a platinum wire wound around the containing receptacle. While this gives a very simple construction, care must be taken in practice not to turn on at once the whole current because the receptacle would crack. Now it is well known that fused quartz has a practically negligible coefficient of expansion. A fused quartz crucible may be heated red hot and will not crack in contact with cold water. For this reason a recent patent of Prof. Wm. H. Bristol, of Stevens Institute, proposes to use in an electric resistance furnace a fused quartz crucible around which the platinum wire is wound. The full current may then be turned on at once without danger of cracking. This not only facilitates the construction, since no rheostats, etc., are required, but it results in a considerable saving of time in the use of the furnace. A furnace employing a quartz tube as the retaining vessel was described by Prof. Bristol before the New York meeting of the American Association for the Advancement of Science, as noted in our issue for January 5, 1907.

While Mr. E. A. Colby's fundamental patents on the electric induction furnace have nearly run out, practical work with this type of furnace in the steel industry has only begun and the present development consists mostly in improving details and covering them by patents. Thus two recent patents of Mr. Colby refer to details of mechanical construction of the weakest point of this type of furnace—the annular crucible which contains the molten charge and which represents the single secondary winding of the furnace transformer.

A recent patent of Mr. G. C. Landis refers to furnaces in which the product is a vapor or gas, as used for instance for making phosphorus. Within vitrified brick walls the carbon crucible is built up in two sets of carbon blocks, forming the one terminal of the furnace. The other terminal is an adjustable vertical carbon rod passing through the center of the lid of the furnace. There are two other openings in the lid, one for charging, the other for the escape of the gases. The molten slag is tapped near the bottom. The furnace is continuous in its operation.

New Telephone Patents.

COMPOSITE SYSTEM.

Of recent years the field for composite systems has been greatly broadened by the appreciation of their general usefulness for railways. For such work the requirements are very different from those of the earlier systems because practically all circuits must be worked grounded.

In Fig. 1 is shown the arrangement just patented by H. O. Rugh, of Sandwich, Ill. It will be noted that the telegraph key is shunted by a condenser and therefore its contacts do not directly affect the telephone circuit. The normal telegraph current splits at the point of the bridge and the arms being

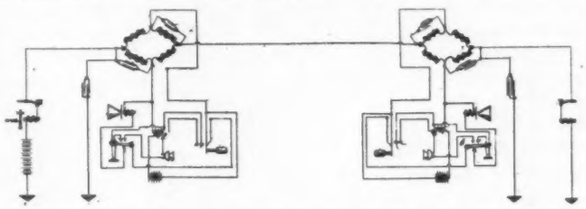


FIG. 1.—RUGH COMPOSITE TELEGRAPHY AND TELEPHONY.

balanced and the telephone circuit therefore being connected to equipotential points, no current escapes to the telephones. Now, on the other hand, all arms of the bridge being of high impedance, are impervious to telephone circuits; the condensers, however, permit its passage. We may, therefore, trace a path from ground to ground through the telephones and condensers, with none but impervious side branches.

TWO-WIRE SWITCHBOARD CIRCUIT.

H. G. Webster has patented a two-wire circuit system in which the cut-off relay is bridged across the jack at all times. The battery and one limb of the line are connected to one end of the relay winding in addition. The line relay current finds its way to ground when a call is made through the subscriber set and line, and a rear contact of the cut-off relay, the returning line limb being connected to the swinging contact of the relay. When a plug is inserted in a jack the cut-off relay comes up, connecting the free limb of the line to the jack and cutting off the ground.

The operation of the system depends upon the supervisory relay failing when in series with the cut-off relay alone, but acting when in series with this, shunted by the line. The Kellogg Switchboard & Supply Company has been assigned the patent.

NEW HOOK SWITCH.

It is quite the fashion now to arrange a hook switch so that the lever may be removed. Such is one patented by G. D. Foster, of Chicago, his patent having been assigned to the American Electric Telephone Company. A piece of sheet metal is punched out and formed up to provide support and pivot for

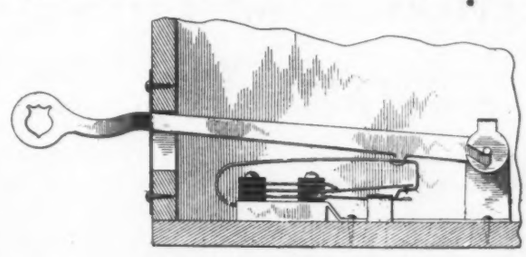


FIG. 2.—FOSTER SWITCH HOOK.

the hook and a support for the springs. Slots lead into the lever support, which turn abruptly upwards near its middle. If the trunnion of the hook be inserted in the slots the upward pressure of the springs will hold it there, so that it cannot become accidentally misplaced. Fig. 2 shows the whole arrangement.

PARTY LINE APPARATUS.

The selective ringing of party line stations has been attacked from many sides. The most obvious and least successful type thus far has been the step-by-step system. This has been patented in, we might safely say, hundreds of forms, and yet not one has had any extended use. This week we have patents for two systems of this kind. One of these comprises the commonplace elements of a ratchet device rotating cam wheels with stops to block the switching levers. In the system there is a rather novel circuit arrangement, but the movements are controlled electromagnetically over an auxiliary wire. This system is the invention of C. H. Wood, of Cleveland, Ohio.

Another adaptation of this type dispenses with the ratchet device, and places at each station a set of relays, which control the continuity of the line in response to the proper sequence of positive and negative current impulses. Such a system is one patented by F. P. Mersman, of Ottawa, Ohio. An entirely distinctive type is that form of selective system wherein the bell at each station is made responsive *per se* to but one distinctive kind of current. There are now several successful examples of this type. One possibility which has attracted inventors is that of harmonic bells, each sensitive to its own frequency. Mr. W. W. Dean has apparently followed this plan of late and a number of patents exhibit various improvements. The latest describes the bell shown in Fig. 3, in which the reed

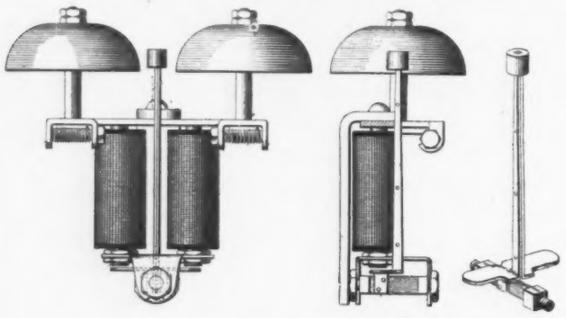


FIG. 3.—DEAN PARTY SIGNAL.

consists of a flat spring clamped with an edge toward the poles, and carrying an armature and the clapper and clapper rod. A tuning must be effected so that the armature will be responsive to the desired periodicity only.

The cumulative effect of the alternating current in tune with the moving system will generate a vibration. It is found that an adjustment must be obtained such that the clapper has a slight free travel to the gong at each extremity of the armature stroke. The recoil then assists in building up the vibration. The adjustment is effected by the screws shown at the base of the gong posts. Mr. Dean has assigned his patent to the Dean Electric Company, of Elyria, Ohio.

Letters to the Editors.

Use of Commercial Hot Wire Instruments for Very Small High Frequency Currents.

To the Editors of Electrical World:

Sirs:—In working with high-frequency currents it often becomes necessary to measure currents of the order of 1-50 milliamperes, and during the past few years several special instruments have been devised by various workers for meeting this requirement. It does not seem to be known, however, that the ordinary low-reading, hot-wire voltmeters have ample sensibility for the purpose if their deflections are suitably magnified. This can be conveniently done by attaching a thin bit of mirror about half a centimeter square to the pointer just below the pivot. The mirror must, of course, be set at a small angle so that it can be observed through the glass front of the instrument. It is also best to set the pointer nearly vertical if it is sufficiently adjustable. The deflections are observed by the usual telescope and scale method.

The instrument which I have used recently in this way is a Stanley 0—3.5 voltmeter having a resistance of 15 ohms. With the scale 130 cm. distant, one milliampere produces a deflection which is easily readable, and 5 milliamp. can be measured with an accuracy of three or four per cent. The readings are not troubled by any but the most violent vibrations and the zero drift is slight.

If, preferred, the same accuracy of measurement can be obtained by attaching a fine bit of quartz or glass fibre to the pointer and observing it through a reading microscope magnifying about 30 times and provided with a scale in the eyepiece.

The calibration curve is made from direct current observations.

L. W. Austin.

National Bureau of Standards, Washington, D. C.

Estimation of Armature Diameter.

To the Editors of Electrical World:

Sirs:—Referring to Mr. L. A. Freudenberger's article on the estimation of armature diameter, in your issue of January 19, page 144, I wish to state that the developments of the formulas (3) and (5) are given in Prof. Arnold's book "Die Gleichotrommachine," Vol. II, page 271, and also in the same author's book "Die Dechselotromtechnik," Vol. IV, page 263. Mr. J. K. Sumek in *Zeitschrift für Elektrotechnick*, 1898, writes equation (3) as follows:

$$\frac{W}{\epsilon} = (10^{-8}\ 5\pi d\pi)\ (c)\ (B)\ (\tfrac{1}{4}\pi.d.l)$$

and expresses it in words:

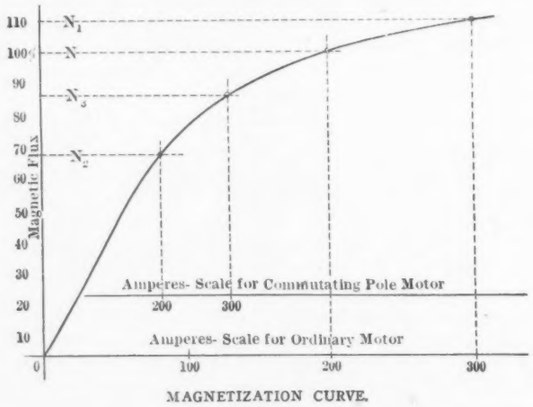
Power transformation = mechanical claim × electrical claim × magnetic claim × total surface of the poles.

Wilkinsburg, Pa. J. L. Heinrich.

Railroad Motor with Commutating Poles.

To the Editors of Electrical World:

Sirs:—A subject of interest to railway engineers at the present time is the possibility of obtaining a greater torque from a railway motor designed with commutating poles than is possible with a motor of the ordinary form; i. e., without commutating poles, assuming that both motors are of the same weight. In order to show that this result may be obtained two motors



MAGNETIZATION CURVE.

may be considered, one with commutating poles and the other of the ordinary type.

Assume that both motors when operating on 500 volts, 200 amperes, are designed to give same speed and torque, and consequently the same output; also, as mentioned above, that both motors are to be of the same weight.

Consider first the ordinary motor. Let the accompanying figure represent its magnetization curve and suppose the motor to be operating on 500 volts and a current of 200 amperes. On referring to the curve it will be noted that the magnetic flux is N. The torque of this motor may be taken as proportional to $200\ K\ N$ where K represents the total conductors on the armature, 200 being the current and N the magnetic flux.

As above stated the commutating pole motor is designed to give the same speed, torque and output when operated on 500 volts, 200 amperes. Now compare the respective torques of these two motors when each is operating on 500 volts, 300 amperes.

Referring to the curve we see that the magnetic flux for the ordinary motor is N_1, which is 10 per cent greater than N. The torque is then proportional to $300\ K\ N_1 = 300\ K \times 1.1\ N = 330\ K\ N$, which is 65 per cent greater than the torque of this motor when operating on 200 amperes.

Now consider the commutating pole motor. In this motor it is possible to use a much greater armature reaction than in the ordinary motor. This being the case it is possible to do with less flux, to obtain the same torque. Assume that an armature reaction 50 per cent greater can be carried in the commutating-pole motor; then K becomes $1.5\ K$ for this motor. The flux for a given torque is then $\frac{N}{1.5} = \frac{2}{3} N$ as compared with the ordinary motor.

Assuming that the magnetic circuits of the two motors are the same; i. e., the same ampere-turns on the field will give the same flux in each motor, the magnetization curve is exactly the same for both motors, but as less flux is required in commutating pole motors for a given torque on account of the increase in K, there will be fewer turns required on its field winding. The number of turns will be made so that when 200 amperes flows, the flux will be such as to give a torque $= 200\ K\ N$; but K being now $1.5\ K$, N becomes $\frac{N}{1.5}$ and is equal to $\frac{2}{3} N$. This flux is indicated by N_2.

Now consider the conditions when operating on 300 amperes. The magnetic flux is now, for the commutating pole motor, N_2, which is $.87\ N$. The torque is then proportional to $300 \times 1.5K \times .87\ N = 390\ K\ N$, which is 95 per cent higher than the torque of same motor on 200 amperes.

This is 18 per cent increase over the torque of the ordinary motor when operating on this same current of 300 amperes. Expressed in another way, the interpole motor will give the same torque on 265 amperes that the ordinary motor does on 300 amperes; for 265 amperes gives $N = .83$, or a torque of $265 \times 1.5K \times .83\ N = 330\ K\ N$, which is the torque of the ordinary motor on 300 amperes.

NEW YORK, N. Y. W. H. WARREN.

A Note on Carborundum.

To the Editors of Electrical World:

SIRS:—During an investigation of the unsymmetrical passage of current through a contact of carborundum and other substances a curious phenomenon was noted. On applying a potential of 10 volts between two points on a crystal of carborundum, the crystal gave out a yellowish light. Only one or two specimens could be found which gave a bright glow on such a low voltage, but with 110 volts a large number could be found to glow. In some crystals only edges gave the light and others gave instead of a yellow light green, orange or blue. In all cases tested the glow appears to come from the negative pole, a bright blue-green spark appearing at the positive pole. In a single crystal, if contact is made near the center with the negative pole, and the positive pole is put in contact at any other place, only one section of the crystal will glow and that the same section wherever the positive pole is placed.

There seems to be some connection between the above effect and the e.m.f. produced by a junction of carborundum and another conductor when heated by a direct or alternating current; but the connection may be only secondary as an obvious explanation of the e.m.f. effect is the thermoelectric one. The writer would be glad of references to any published account of an investigation of this or any allied phenomena.

NEW YORK, N. Y. H. J. ROUND.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers:

Magnetic Leakage.—CRAMP.—A paper read before the Manchester section of the British Inst. of Elec. Eng. on magnetic leakage and its effect in electrical design. Magnetic leakage generally is of two kinds: (1) That which opposes the attainment of the ideal characteristic at which a designer aims in any particular machine; (2) that which assists the designer to attain the end at which he aims. As examples of the former in continuous-current machinery, we have flux which is linked with field turns, but not with the armature turns; also flux set up by the armature tending to destroy the field; and corresponding to these in alternating-current machines there is self-induction of stator and rotor windings. This type of leakage the author calls harmful leakage. As examples of the second kind which the author calls useful leakage there are, in direct-current machinery, leakage into the sides of the teeth of the stampings, and special leakage from pole to pole, arranged with the object of improving commutation, etc.; while in alternating-current machines there are specially arranged leakage paths to increase self-induction for constant-current purposes, etc. The author then discusses leakage in the field systems of direct-current machines and reaches the following main results: In machines up to 20 hp the leakage is sufficiently great to make it worth while to adopt special means to reduce it; one of the best remedies is the placing of the field coils close to the armature and practically spanning the pole pitch; a single coil may be adopted in place of the usual one coil per pole, but this is not, as a rule, economical; the single coil will be more economical than the separate coils if the length of mean turn of the single coil is less than the length of mean turn of any one of the separate coils multiplied by half the number of poles; adopting either of these methods of field winding incidentally reduces both the weight of iron and the cost of the machine, and at the same time improves the commutation; as the general result, therefore, smaller machines at a reduced cost can be built for the same output. The logical deduction is that if both the field and the armature coils are placed upon the armature the results will be still better, since any harmful leakage is then converted into useful leakage. This arrangement is possible with a series motor, but two considerations must be taken into account: First, the field coils being distributed about the circumference of the armature will not have along the field brush axis the effect of a concentrated coil producing the same ampere-turns, but only about $2/\pi$ times this value. Second, the leakage factor will, so far as mutual induction between the armature and field coils is concerned, be practically unity. The first consideration to some extent discounts the second. This design will, therefore, be useful only in special cases where it is worth while to make the yoke and poles either exceedingly cheap or exceedingly light. If cheapness is desired, a simple iron casting bored

out is all that is necessary; if lightness is desired cast steel may be used, and in either case the magnetic circuit is economical because very short, so that the over-all diameter of the machine will, if the armature dimensions are not much increased, be much reduced by the new construction. The author has made some experiments to test his theories. The paper is to be concluded.—Lond. *Elec. Eng.*, January 18.

Alternating-Current Armature Windings.—Hobart and Ellis.—The conclusion of their serial on alternating-current armature windings and their classification. They discuss the development of polyphase windings (two-phase and three-phase, whole-coiled and half-coiled windings), and the number of ranges and divisibility of armature as affected by true three-phase and six-phase grouping, together with general conditions for various types. Consideration is given to short-coil and skew-coil windings, wave windings and retrogressive wave windings, and their development from simple fundamental windings and parallel connection of armatures. A general scheme is given for nomenclature and classification of alternating-current windings; (1) Single or polyphase, (2) whole-coiled or half-coiled, (3) single-coil or multi-coil, (4) uni-slot or polyslot, (5) spiral, lap or wave winding. The article concludes with rules for star and delta-connection of three-phase windings, and the application of a nomenclature scheme showing that the properties of a winding may be completely defined by its title.—Lond. *Elec.*, January 11 and 18.

Iron Alloy for Electric Machines.—A note giving some further information on the new patented alloy called "stalloy," which is being introduced for use in electrical apparatus. In this alloy the hysteresis and eddy-current losses have been reduced far below those of the best brands of iron and steel hitherto obtainable. The same manufacturers' own special alloy, "lohys," is not nearly as good. The left-hand diagram of Fig. 7 shows the average total loss in sheets of various

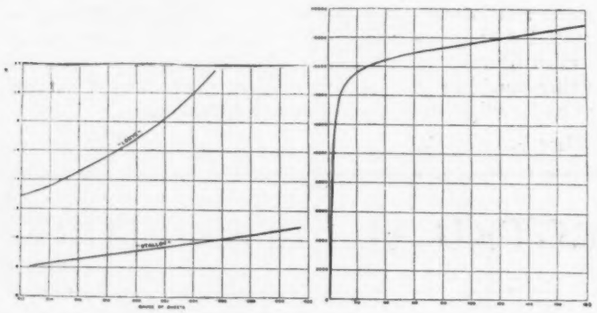


FIG. I.—CURVES OF TEST OF IRON ALLOY.

thicknesses (given as abscissæ) at $B = 10{,}000$, 50 cycles for both special alloys. The hysteresis loss of stalloy is only 0.2 watt per pound at $B = 4{,}000$ and 100 cycles whereas with lohys it is 0.4 watt. With stalloy thicker sheets may be used and therefore handling and stamping may be reduced and less space is wasted with insulating material. In designing electrical machinery the special qualities of stalloy may be taken advantage of for reduction of size, increase of output, improvement of efficiency or lower working temperature. The right-hand diagram shows the variation of B with H throughout the usual working range.—Lond. *Elec. Rev.*, January 18.

Pulsations of the Field in Teeth.—Bragstad.—While the rotating member of a machine moves relatively to the stationary member, a tooth of one member passes alternately a tooth and a slot of the other member. This causes a variation of the magnetic reluctance for the lines of force through a tooth, whereby pulsations of the magnetic field in the tooth are produced which result in losses in iron, mainly due to eddy currents. These losses act like a breaking effect. The author shows in the present article how the amplitude of these pulsations may be directly measured and how the corresponding losses can be approximately calculated. The formulas thus derived are compared with values found by measurement in order to prove that these losses are really due to pulsations of the field in the teeth.—*Elek. und Masch.*, December 30.

Calculating Magnet Coils.—Edmer.—The conclusion of his mathematical paper on formulas for calculating the magnet coils used for relays for the operation of switches, etc. In the concluding installment the author gives numerical examples of the application of his formulas.—*Elek. u. Masch.*, December 30.

Interpoles.—Ellis.—An elementary outline of the fundamental formulas for calculating interpoles.—Lond. *Elec. Times*, January 10.

Lamps and Lighting.

New Incandescent Lamps.—Swinburne.—A paper read before the British Inst. Elec. Eng. The author discussed the difficulty of making high-voltage metallic filament lamps. If the surface emission for the lamps is the same, the e.m.f. varies directly as the square root of the cube of the length of the filament. Other things being equal, a 200-volt filament is nearly 1.56 times the length of the 100-volt filament and about two-thirds of the diameter. It is thus very much weaker. Weakness is not by any means the only consideration, however. The slow wearing of the surface causes a greater percentage difference in the resistance of the lamp, and there is double the e.m.f. available for causing discharge across from one leg of the filament to the other. The only way the lamp maker can reach high e.m.f's, other things being equal, is by increasing the size of the lamp—that is to say, making 16 instead of 8-cp lamps, and so on. How are lamp makers to get the metal wire so fine that it will take, say, 200 volts? If a carbon lamp of 200 volts and 16 candles has a consumption of 4 watts per candle, it must have a resistance of 625 ohms. A metal lamp, however, is made to work at, say, 1.33 watt per candle, and that means that for 16 candles there are only 21.4 watts. This means a resistance of 1,870, or nearly 2,000 ohms, as compared with 625 ohms. There are two influences which help the metal lamp, however: the resistance of the metal rises considerably with the temperature, as a metal is run not very far from its softening point, and the emissivity of bright metal is less than carbon, so that to give the same light at the same specific consumption the wire may be larger. It seems probable, however, that bright metal surfaces increase in emissivity as they get hot—that is to say, they get "blacker" as they get hotter, a "black body" being brighter at a given high temperature than a white body. In considering what metals and compounds are valuable for lamp filaments, we have to consider the melting point, the specific resistance and the possibility of making the filaments in practice. In a general way high melting points correspond with small atomic volumes, and electric conductivity seems to follow the same sort of rule. There are various methods of making filaments. A carbon filament may be made first and this may be coated by electrical heating with other substances and the carbon can then be volatilized. (This plan "has a heroic ring about it, which promises a lamp capable of very high efficiency; but I want to see it done. Most metals are likely to form carbides rather than let the carbon go off.") A wire may also be deposited electrolytically from a solution. The material may be ductile, in which case it is drawn into wire in the usual way. The material may be made into a very fine, smooth powder and mixed with some agglomerant and squirted; the squirted filament is then dried, baked and heated electrically to get rid of carbon if an organic binding material has been used. An oxide may be mixed with carbon and made into a paste and squirted; the filaments after making are heated electrically in vacuo; carbon then reduces the oxide, making either metal or carbide according to the proportion of carbon employed; the carbon may be supplied by heating in hydrocarbon vapor. The oxide may be made into a rod and run like a Nernst filament except that the process is carried out either in vacuo or in hydrocarbon gas, so that the oxygen is removed, leaving metal. The addition of a very little of one metal to another may be worth while if it increases the specific resistance very considerably and lowers the melting point very little. Where a trace of infusible metal is added to a fusible metal the first result is generally to reduce the melting point; but after a very small

percentage the melting point rises very rapidly. If we begin with the infusible metal, the addition of the fusible component brings the melting point down very rapidly. In alloying two metals of about equal melting temperatures the first addition of either brings the melting point down rapidly. The author then discusses the chemical and physical properties of all those elements which are most likely to be suitable for filaments.—Lond. *Elec.*, January 18.

Zirconium-Tungsten Filament Lamp.—Some particulars on the "Zircon-Wolfram" metallic filament lamp suitable for pressures from 200 to 220 volts. It was invented by Zernig. "The filament was originally made of zirconia mixed with carbon." This gave a high-efficiency filament, but only suitable for low pressures. Subsequently tungsten was introduced. As to the exact process used, it is difficult to obtain any exact information, but it appears that it depends upon utilizing hydrogenous combinations of metals. The material that is obtained is in snch a form that the filaments can be made by a process of squirting. The introduction of tungsten into this particular lamp has enabled an extraordinarily rapid advance to be made in the pressure at which it will run. Thus, although the pressure was only 37 volts rather more than a year ago, this pressure has now been raised to 220 volts. Lamps are at present made for 16 candles on 100 volts, or 32 candles on 200 volts. The cost of manufacture is said to exceed that of the carbon filament lamp by not more than 2 cents per lamp. The lamp is claimed to run equally as well on alternating as on direct current. It is not fragile and the consumption is given as about 1.2 watts per candle.—Lond. *Elec.*, Jan. 18.

Incandescent Lamp Standards.—The long-expected specification for carbon filament incandescent lamps has been issued by the British Eng'ing Standards Committee. The British light standard shall be the 10-cp Vernon-Harcourt pentane lamp at the British National Physical Laboratory, from which carbon filament secondary standards shall be derived. The useful life of a lamp is completed when the mean horizontal candle-power has dropped 20 per cent. Four classes of standard lamps are recognized, having lives of 400 and 800 hours, respectively, and made for 110 and 220 volts; these are distinguished by reference letters, which also indicate the standard consumptions. Thus, for 16-cp lamps, *A* represents a 400-hour, 50-watt lamp for 110 volts; *B* a 400-hour, 60-watt lamp for 220 volts; *C* an 800-hour, 56-watt lamp for 110 volts, and *D* an 800-hour, 66-watt lamp for 220 volts. The reference letter (in a circle), voltage and mean horizontal candle-power, are to be marked on each lamp bulb, with the name or trade-mark of the manufacturer. The candle-power is to be determined at standard pressure, while the lamp is revolving at 200 r.p.m. about a vertical axis. The average limits between which the results must fall are 8 per cent for the candle-power and 5 per cent for the total watts, but individual lamps are allowed about 60 per cent greater latitude; the watts per m.h.cp. are limited to 16 per cent from the standard. Life tests are to be carried out on a circuit whose voltage is never more than ½ per cent above normal, the pressure being adjusted at the start so that the lamp is burning at its standard consumption, and the average total candle-power-hours during the useful life must not fall below 90 per cent of the standard figures. The ratio of mean spherical to mean horizontal candle-power is to be not less than 0.8.—Lond. *Elec. Rev.*, January 18.

Searchlight.—KOENIG.—A paper on parabolic mirrors with electric incandescent lamps. Their advantages are pointed out and the equations for calculating them are given.—*Elek. Zeit.*, January 17.

Power.

French Power Transmission Plant.—BRUNHES.—A description of the electric installations of the city of Grenoble in France. The hydraulic station in Livet on the Romanche (a tributary to the Isere) utilizes a fall of 60 meters with an almost constant quantity of water of 25 cubic meters per second for 8 months. In winter, however, this quantity sometimes decreases to 6 or 8 cubic meters per second. The one part of the plant containing six alternators each of 1,250 hp is used for electrochemical purposes, while the other part with three sets each of 2,500 hp serves for power transmission to the city of Grenoble. The turbines operate at 375 r.p.m. with an efficiency of 78 per cent at full load. Fly-wheels of eight ton weights are inserted between the turbines and dynamos. The generators give three-phase currents at 3,500 volts and 50 periods. In order to increase the voltage at full load to 4,350 volts, auxiliary windings are provided by means of which the number of coils per pole and phase can be increased from 7 to 8. For transmission the voltage is raised by means of transformers to 26,000 or 32,000 volts. The transmission line has a length of 38 km. In the sub-station in Grenoble the voltage is reduced to 5,000.—*Ass. Ing. El. de L'Inst. Montefiore*, Nos. 1, 2, 6, 7, 1906; abstracted in *Elek. u. Masch.*, December 30.

Motive Power.—MATHOT.—In a continuation of his serial on the choice of motive power for workshops, the author gives comparative figures on the operating costs and running expense of steam, gas and oil engines, the first cost of installation having been discussed in a former article.—*Eng'ing Mag.*, February.

Suction Gas Plant.—STEVENS.—A paper presented before the South Wales Inst. of Engineers, giving an account of the actual working of a small suction gas plant consisting of two duplicate plants of 39 hp. From a week's test with coal at $5.25 per ton the total cost of the hp-hour was found to be 0.9 cent, while the same figure from the working over six months comes out as 0.926 cent.—Lond. *Elec.*, January 18.

Gas Power.—DIXON.—In the present installment of his serial on the planning and construction of the power plant the author discusses gas producers and gas engines.—*Eng'ing Mag.*, Feb.

Traction.

High-Voltage, Direct-Current Locomotive.—An illustrated note on three Siemens-Schuckert locomotives built for a metallurgical plant in Germany. The total length of the road is 15 km., the maximum grade three per cent, and the highest speed 30 km. per hour. The weight of each locomotive is 56 tons and that of a train with locomotive about 320 tons. The direct-current voltage against earth is 2,000 volts. Each locomotive is equipped with four motors each of 160 hp.—*Elek. Zeit.*, January 10.

Canal Haulage.—THWAITE.—A summary of the different electrical methods of canal haulage with a classified review of the relative advantages and disadvantages of the different methods. The article is to be continued.—Lond. *Elec. Rev.*, January 18.

Trolley Wires.—SHEARDOWN.—A paper read before the Dublin section of the British Inst. Elec. Eng. on the causes and remedies of the breaking of trolley wires.—Lond. *Elec. Rev*, January 16.

Installations, Systems and Appliances.

British Central Station.—A fully illustrated description of the new municipal central station of the Metropolitan Borough of St. Marylebone. While part of the old plant operated by a private company was taken over and paid for by the municipality, a complete and entirely new and up-to-date municipal station was erected. It contains four 500-kw turbo units and two 2,000-kw turbo units. Direct current is generated to supply a three-wire system with 480 volts across the outers. Power is supplied at 240 volts for lamps and at 480 volts for motors. For the 2,000-kw sets the steam consumption was guaranteed not to exceed, at full load, 20 lb. per kw-hour measured on the switchboard with 100° F. superheat; for the 500-kw sets the steam consumption under the same conditions is 21 lb. per kw-hour, deducting in both cases the power taken by the auxiliaries. The machines have a 25 per cent overload capacity for one hour and 50 per cent momentarily.—Lond. *Elec. Rev.*, January 18.

Systems of Charging.—TOPPIN.—After a review of the uniform rate, the maximum-demand rate, the standing-charge system, the sliding-scale system and the double-tariff system the author describes a new system of his own in which, in addition to the ordinary meter, an additional hour-meter is required. On the consumer starting to use a certain proportion of his

full load—say 1/10 of the maximum possible power—the clockwork is released by an electromagnetic device and commences to record the length of time the power is in use. The price per kw-hour is based upon the number of hours the power has been in use during the quarter.—Lond. *Elec. Eng.*, January 11.

Connections to Supply Stations in the United Kingdom.—Diagrams showing the growth of connections to supply stations in London and in the Provinces. The larger proportion of connection in the Provinces are to municipal stations, while in London they are to private companies. Both in the Provinces and in London the connections to stations supplying only direct current show a large increase. Stations supplying both alternating and direct current remain about the same as last year. The total private lighting connections in London and the Provinces represents the connection of 22,886,700 lamps of 8 cp, while the total connections, including motors and public lamps, are equivalent to 36,377,170 lamps of 8 cp; that is, private lighting is equivalent to about 63 per cent of the whole.—Lond. *Elec.*, January 18.

British Central Station Statistics.—Statistical tables giving a very large amount of information on the history and equipment of British stations. The first table refers to towns taking electricity supply "in bulk"; there are 21 such towns. The second table refers to stations supplying both lighting and tramways; there are 125 such stations.—Supplement to Lond. *Elec.*, January 18.

Switchboard.—Beckmann.—An illustrated description of a new switchboard for the electrical laboratory of the Institute of Technology of Hanover.—*Elek. Zeit.*, January 10.

Wires, Wiring and Conduits.

Transmission Line Support.—A note on the Lucerne-Engelberg transmission line in Switzerland, which is 16.7 miles long and has certain interesting constructional details. It is a polyphase 25,000-volt line and runs along a steep, rocky mountain side by the banks of Lake Lucerne. The road extends along the foot of a wooded precipice, on the immediate side of the lake. The outer edge of the road is occupied by a telephone and telegraph line of some 20 wires, and it was necessary to keep the transmission line well away from these wires. Owing to the fact that the bottom of the lake falls away very steeply, it was impossible to set poles or towers any distance from the shore. The danger of occasional falls of trees or rock from the mountain side made it advisable to keep as far from the mountain side as possible. As a solution of these difficulties the construction shown in Fig. 2, comprising cantilever supports for the transmission line towers, which carry the line some 20 ft. out from the bank, was devised. The masonry foundations and anchorage is topped with a wall on the land side to protect the pole against falls of debris from the hillside.

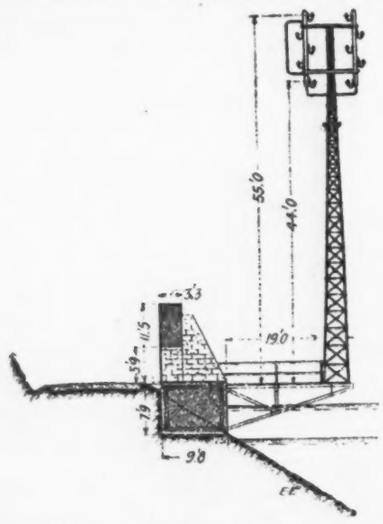


FIG. 2.—TRANSMISSION LINE SUPPORT.

In order to reduce the number of these special towers, the normal span length of 200 ft. was increased to twice this amount on the section concerned. The pole top used on this line is also of interest. Two transverse steel channels riveted to the tower carry oak uprights at their outer ends. The insulator supports, of galvanized iron, are fixed to the uprights in staggered arrangement, with a spacing of 39 in. between wires. On curves, iron guards, as shown in the drawing, surround the outer and bottom rows of wires.—Lond. *Elec. Eng.*, January 11.

Wiring.—Munro.—A paper read before the students' department of the Glasgow section of the British Inst. Elec. Eng. The author describes the various systems of wiring which have been tried and points out their disadvantages and the precautions which have to be adopted. He also explains how to make the neatest job as well as the most satisfactory one.—Lond. *Elec.*, January 11.

Electrophysics and Magnetism.

Alpha Particles from Radioactive Substances.—Rutherford.—The alpha particles expelled from the different radioactive substances have the same mass but differ in the initial velocity of their projection. Under the normal conditions of experiment, the alpha particle carries a positive charge and behaves as if it were a charged atom of matter (an atom of helium?) projected from the radioactive matter at very great velocity. The initial velocity of expulsion of the alpha particle from each alpha-ray product is a definite constant which, like its period of transformation, serves to distinguish it from all other products. The initial velocities all lie between 1.56×10^9 and 2.25×10^9 centimeters per second; the alpha particles emitted from thorium C have the greatest velocity and those from uranium and radium the least velocity. In a large proportion of the products the velocity of expulsion of the alpha particle for each of the radioactive families increases progressively as the period of transformation decreases. Since the period of transformation of a product may be considered to be an inverse measure of the stability of the atoms composing it, this would show that the velocity of the expulsion of the particle is a function of the stability of the atoms and is least for the most stable atoms.—*Phil. Mag.*, January.

Radioactinium.—Hahn.—The author has formally described the methods of separation of a new product of actinium, called radioactinium, as its position in the disintegration series of actinium is the same as that of radiothorium in the thorium series. In the present paper he gives the results of a detailed study of its properties. Radioactinium is produced directly from actinium and is the direct parent of actinium *X*. The transformation of actinium into radioactinium is rayless. Radioactinium emits only alpha rays and is half transformed in about 19.5 days.—*Phil. Mag.*, January.

Electrochemistry and Batteries.

Sterilization of Effluents.—Phelps and Carpenter.—An account of an extended investigation made at the Mass Inst. of Techn. on the sterilization of sewage-filter effluents. The following sterilizing agents are discussed: Heat, lime, acids, ozone, chlorine and its compounds (chlorine gas, oxychlorides, chloride of lime, hypochlorites), copper and its compounds, permanganate, amines. Among these sterilizing agents chlorine, either as chloride of lime or as free gaseous chlorine, appears to have the highest cost efficiency. An amount of the former which will yield 5 parts per million of available chlorine was found to have destroyed 99.96 per cent of the total bacteria and practically all of the B. coli present in the effluent of a trickling filter treating crude Boston sewage, the time of contact having been two hours. The estimated cost of such treatment is $1.05 per million gallons of sewage. The use of gaseous chlorine, manufactured at the disposal works by electrolytic methods, would in the case of larger works considerably reduce this cost. An approximate estimate places the cost of such treatment at about 85 cents per million gallons of sewage, allowing 5 parts of chlorine per million. It is probable that the chlorine in

this form is somewhat more efficient. The process is entirely feasible and in the case of large works it is cheaper than sand filtration.—*Technology Quart.*, December.

Electric Steel.—EICHHOFF.—After a general discussion of electric furnace methods in iron and steel metallurgy the author describes the Héroult electric furnace in a plant in Remscheid, Germany. In quality the steel produced by this process is stated to excel nearly all crucible steels. Some data are also given on the cost of the process.—*Iron Age.*, January 31.

Fixation of Atmospheric Nitrogen.—ERLWEIN.—A paper read before the Berlin Electrical Society on the fixation of atmospheric nitrogen in form of cyanamide, and the use of cyanamide as fertilizer and as starting material for making cyanide and other products.—*Elek. Zeit.*, January 10 and 17.

Electric Furnace.—KERSHAW.—The first part of an illustrated and somewhat popular summary of those electric furnace methods which have been proposed or introduced into practice for iron and steel production.—Lond. *Elec.*, January 18.

Units, Measurements and Instruments.

Cymometer.—The conclusion of the article on the Fleming direct-reading cymometer and its application. In the present installment the measurement of the decrement of the oscillations in an oscillatory circuit is described.—Lond. *Elec.*, January 18.

Interrupter.—GOLDSCHMIDT.—A description of an interrupter, the chief features of which are sparklessness, small development of heat and easy control of frequency. It is essentially based on the fact that if a closed circuit contains two metal pieces in contact and if these two metal pieces are placed in an electrolyte, then the contact between them may be broken without the production of any spark. In a hard-rubber box a revolving axle is provided on which are fixed lead blades. A lead plate is placed on the bottom of the box. This lead plate is connected to one pole of the circuit, and the revolving axle to the other pole. Electrolyte is then filled to a certain height into the box. Whenever one of the blades leaves the liquid, the circuit is broken, without any sparks.—*Soc. Belge d'Elec., Bull. Mensuel*, January.

Three-Phase Power Measurement.—SCHEIBE.—A note giving a brief proof, without mathematics, of the method of measuring the power in a three-phase circuit by two wattmeters.—*Elec. Jour.*, January.

Telegraphy, Telephony and Signals.

Disturbances on Telephone Lines During Snow Storms.—A note on some observations made by Havelik on several Continental telephone lines on which considerable disturbances were produced during the last few winters. After a heavy snow storm sparks appeared at the lightning arresters, the silk covering on some of the wires became burned in places, and the alternating-current bells began to ring. The 0.5-amp. fuse wires were not, however, affected. Communication over the line was impossible owing to the loud reports heard in the receiver, but after a short time the phenomena disappeared and conversation could be resumed. Lines equipped with carbon lightning arresters suffered in the same manner. The cause of these disturbances was put down to snow flakes charged with electricity charging the overhead telephone lines to a considerable voltage. When the pressure reached a certain limit a discharge took place by way of the lightning arrester. These phenomena were not so noticeable with the less sensitive arresters formerly in use, and it was found that earthed induction coils entirely prevented their occurrence.—Lond. *Elec.*, Jan. 18.

BOOK REVIEW.

ALTERNATING-CURRENT MOTORS. By A. S. McAllister, Ph.D. New York: McGraw Publishing Company. 272 pages, 122 ills. Price, $3.00.

A critical survey of this work reveals to the reader two striking characteristics; namely, the familiarity of the author, both experimentally and theoretically, with the subject in hand, and his ability to express his arguments and discussions in lucid and logical language. Thus, for instance, on page 166, in a few words, he makes perfectly clear to any one at all familiar with electrical apparatus why under-excitation in a synchronous machine causes a lagging current while over-excitation causes a leading current to be drawn through the mains. Though it is usually considered necessary in explaining this phenomenon to use a vector diagram, the succinct explanation given in words alone is entirely convincing.

In the preface it is stated that mathematics are employed merely as an aid or tool. The author has adhered to this practice strictly throughout the book; but, though few mathematical formulas are used, especially in the first half of the work, it will be found that nearly every sentence is full to the brim of stiff reasoning. The work strikes deeply into the foundation of the subject and little time is wasted in puerile description or repetition.

Care has evidently been exercised throughout the treatise to express accurately what is intended by the use of any term. Thus, there can be no plausible excuse for the reader confusing electromotive forces and currents, field strength, magnetic flux, etc. The use of the term "quadrature" under conditions where "wattless" is frequently employed is commendable, as is also the simple method adopted of reducing polyphase qualities to the terms of equivalent single-phase circuits. When giving formulas, the author is careful to specify the meaning of each symbol used at the beginning of all discussions—a desideratum which is sometimes neglected by others to the needless confusion of their readers.

The book begins with simple discussions, which will be readily understood by the student or engineer who has had a fundamental training in electricity and magnetism including the first principles of dynamo-electric machinery, and advances in such gradual steps in difficulty or complexity that the reader is carried along with scarcely an appreciation that he is getting deeper and deeper into a somewhat intricate subject.

The book opens with a brief review of methods for measuring power and of the economical use of conducting material. It then takes up a simple outline of induction motor phenomena, dealing with the production of a revolving field and giving simple analytical equations which, in connection with the subsequent chapter upon methods of testing, including the results of actual performance, brings to the reader a true appreciation of the fundamental principles upon which the alternating motor is based. Then follows a simple and thorough discussion of induction motors as frequency converters, which in turn is followed by a discussion of the Heyland induction motor.

Beginning with chapter VI elementary explanation is dropped to a large extent and the more complex phases of the subject taken up. It will be noticed, however, that in this chapter, as in the entire treatise, the discussions and analogies begin with fundamental principles and leave little to be taken for granted. Chapter VII is a continuation of the former, but takes up graphical treatments of the induction motor using the circle diagram. The table in this chapter on page 67, giving the results of an actual test, is valuable and is, with others, among the admirable features of the book; by this means the author, having developed a principle through reasoning, proceeds to show by test results taken from a machine suited for commercial service that his theoretical deductions are borne out by practice. Chapter VIII continues the argument and deals with asynchronous generators, extending the principles previously developed to a wider field. One of its best portions is the treatment of condensance. In this chapter may be noted another of the useful features which are carried consistently through the work; that is, the brief practical instruction for testing and using the machinery and phenomena under consideration. This instruction is so presented as to be of direct use to the engineer who is consulting the work for the purpose of obtaining information regarding the operation of his plant.

The next chapter diverges slightly from the previous line of argument and takes up the transformer features of the induction motor, aptly presenting a simple explanation of the electrical circuits which are equivalent simultaneously to a transformer

and a motor. The discussion of the induction motor proper is ended with a chapter on the magnetic field. The latter part of this discussion, dealing with the single-phase motor, may be found to be a little difficult as it is a somewhat detailed dissection of the currents and fields.

The next step is a study of synchronous motors and converters. In treating these machines the author assumes that the reader possesses a thorough knowledge of the simple conceptions of the action of the synchronous motor, or of alternators in parallel, including the effect of the synchronizing current which flows between such machines. It might have been better if a few paragraphs dealing with the synchronous motor and including the fundamental diagrams had been inserted here. This lack, however, will not be felt greatly in college classes where the work is used as one of the final parts of the course in alternating-current machinery, or by such engineers as are familiar with synchronous machinery. The chapter begins with the electromotive forces in synchronous commutating machines, the heating of the coils, the flow of the current, and gives a most satisfactory table of actual results. The explanation of the characteristics of synchronous converters, their excitation, the phenomena of hunting, methods of starting, the reasons for compounding, and the action in inverted converters is exceptionally good. A little more space might have been given to the operation of inverted rotaries, and to the starting of synchronous motors driving alternating-current generators; but it must be admitted that the explanations, so far as they go, touch the heart of the subject. This division of the study ends with the determination of the performance of synchronous motors and a practical discussion of methods for transformation from two and three to six phases for the use of converters.

The next department of the treatise, opening with a discussion of methods of measuring electromagnetic torque, is a study of single-phase commutator motors and should prove most useful at the present day when machines of this type are entering the industrial field as an acceptable method for transforming electrical to mechanical energy. The study begins with a simple treatment of the repulsion motor by diagrams, calculated performance, and experimental data. This preliminary is followed by a more thorough analysis of the electromotive forces and magnetic fields produced in such motors including not only diagrams but essential mathematical discussions. The mathematical treatment is somewhat extended but is only such as is essential to a thorough understanding of the subject. The compensated repulsion motor is given full consideration. The discussion of the repulsion motor is followed by an equally comprehensive one upon series motors. Here the study begins with the plain series motor, followed by compensated motors, induction series motors, the use of shunts, etc. In this chapter the discussion makes much use of mathematical explanation, but also develops the results in the form of diagrams and practical data. The treatment of repulsion and series motors is probably not equaled for simplicity and clearness of explanation by anything heretofore published and forms the part of the work most valuable for reference. The book ends with a short discussion of sparking and its prevention in single-phase commutator motors.

The illustrations throughout are clear and are designated by titles sufficiently explanatory. The entire work is divided into short chapters and convenient sub-headings. It would have added something to the convenience of the book if a system of cross references had been included and if all important statements, rather than merely a few, had been printed either in italics or in heavy type. The index could with advantage have been more complete. Nevertheless, the general arrangement leaves little to be desired. Though errors are more or less excusable in a first edition, this work seems to be unusually free from them.

The book comes at an opportune time to supply a want which has heretofore been indifferently filled, and which at the present time, when the alternating-current motor is being introduced for traction purposes, is most pressing. Commendation is due especially for the originality of much of the presentation and for the new and valuable information introduced from the author's own experience.

The Edison Club of Schenectady, N. Y.

By F. M. Feiker.

It has been said that Schenectady, N. Y., houses more technical men in proportion to its population than any city in the world. The word "houses" is used advisedly for to the great proportion of the technically trained young men who come each year to the shops of the General Electric Company, the work there undertaken is a post-graduate course in technics. Four years in a college or technical institution primes a man with theory and some practical work gained during summer vacations. Coming, then, to the shops of a great manufacturing establishment, the two or three years there spent in practical work prepare him for the larger industrial life. After this absorptive training in the atmosphere of modern commercial conditions the young engineer is prepared to solve the problems of railway, lighting and power. Each year the need for this experience becomes more evident and men come from the institutions of the United States and from the various countries of the world to take this advanced course, while another small army of embryo engineers leave the training grounds equipped for the world's work. Some men undertake pure engineering for their occupation, others go in for the commercial side of the engineering professions at the same establishment, while a good number elect one of these lines of activity in fields of electrical utilization.

Such conditions naturally lead to co-operation and the common purposes and work of four or five hundred men bind

FIG. 1.—SUNDAY MORNING GROUP.

them into a more or less homogeneous body. The Edison Club, having for its aim the development of the social and intellectual life of its members, is the outcome of this association in Schenectady. In 1903 five men in the testing department at the works of the General Electric Compjany proposed the organization of such a body, and in March, 1904, the society was formally organized under the title of the "Edison Club," with a charter membership of one hundred and fifty men. At the start membership in the club was restricted to those technical men engaged in the testing of electrical machinery, popularly termed "test-men." As the scope of the organization broadened, however, a more elastic requirement was substituted, membership being dependent only upon technical training of those connected with the General Electric Company. This requirement was urged so that the club might continue primarily as an engineering society. At present the roll includes over 350 men, and it is interesting to note that more than 700 men now scattered about the world were one time members of the organization during their work in the General Electric Company's testing department.

One of the most attractive features of the Edison Club is its summer home. The illustrations appearing with this article convey some idea of the beauty of the location. The building has been occupied by the club for about two years. Formerly, the present club headquarters were the home of Schenectady's coun-

try club, the Mohawk Golf Club, and it is through the generosity of that organization as well as the General Electric Company that the Edison Club now leases the property. The grounds comprise several acres of land at the crest of a hill which commands a fine view of the Mohawk valley. From the wide verandas of the house, across the city to the west, the outlook is particularly fine, with its glimpses of river and the Adirondack Mountains beyond. The house is a low rambling structure of one story facing the west and north. The main portion of the

FIG. 2.—SUMMER QUARTERS OF THE EDISON CLUB.

building is made up of a single large hall one end of which is flanked by a huge stone fireplace. From the main room doors lead to the caretaker's apartments and to the locker rooms. The walls of the main room are decorated with pennants from all the colleges, given by members of the club. The room is simply furnished. Here in the main room throughout the summer months informal fortnightly dances are held, with an occasional smoker. Other amusements are enjoyed occasionally.

Aside from the informal dances and music, the social side of the club is fostered during the warm months by tennis and baseball. There are four excellent tennis courts which the long summer evenings and the week-ends find well filled with players. Each year a tournament is held. On the first year of the club's organization, tennis was made doubly interesting by the presentation of a prize cup. This cup, the gift of Mr. E. B. Raymond, of the General Electric Company, is contested for annually, the winner holding the trophy for the ensuing year. Near the tennis courts is the base-ball diamond, and Saturday afternoons the Club team plays the national game

FIG. 3.—THE UPPER TENNIS COURTS.

with other local teams as well as out-of-town organizations.

During the winter the more serious side of the club is carried on in conjunction with social and athletic events. The club occupies rooms in the city, and lectures are delivered on technical subjects by engineers of the General Electric Company. The officers and engineers of the company are particularly interested in this feature of club life and as a consequence these papers and talks are educational and timely in their treatment of engineering subjects. Last winter prominent officials of the company lectured before the men in the assembly hall of the Schenectady Public Library. The subjects of these papers were varied and pertinent to the work of the club members, ranging from questions of shop management and the commercial aspects of business to theoretical and practical considerations of special engineering topics. As each lecturer is a specialist in his subject, the weekly course is invaluable, particularly as it goes hand in hand with the practical work in the shops. This educational feature of the work will be made of even greater personal value during this coming winter by the establishment of a question box. Members of the club will prepare questions which from time to time will be grouped in headings and talked over informally under the leadership of some prominent engineer of the General Electric Company. Last year the lectures included such subjects as "Shop Management" by Mr. G. E. Emmons, Mgr., of the Schenectady Works: "Heavy Traction Work," by Mr. A. H. Armstrong, of the Railway Engineering Department; "Theory of the Steam Turbine," by Mr. C. P. Steinmetz; "Rating of Railway Motors," by E. H. Anderson and a consideration of "Foreign Business," by Mr. M. A. Oudin, assistant manager of the foreign department. Supplementing the lectures are smoke talks; through the courtesy of the trade press, the various periodicals are kept on the club's reading tables.

During the autumn the club monogram is in evidence on basket-ball jerseys and a good team is turned out, although practice is, of course, confined to evenings and Saturday afternoons. Last winter the club supported a successful polo team.

All this activity is carried on through the various committees, the organization of the Edison Club being as follows: President, J. B. Crane; vice-president, C. L. Proctor; secretary, W. H. Tenny, and treasurer, E. J. Cheney. These men, with the chairmen of a house committee, entertainment committee, athletic committee and finance committee, form the executive board. Initiation fee and dues are purposely made small so that the financial strain upon individuals is very slight. While not directly connected with the General Electric Company, the club obtains many favors by the courtesy of Mr. A. L. Rohrer, the company's electrical superintendent, and Mr. G. E. Emmons, manager of the Schenectady works.

Tests of Flexible Cord.

The Wire Inspection Bureau affiliated with the Underwriters' Laboratories, 43 Cedar Street, New York City, has issued a circular letter dealing with the authorized testing of pendant and portable flexible cords. As the matter is one of general interest, the terms of the circular are quoted below:

"After several conferences between joint committees formed by representatives of the insurance interest and the advisory committee of the flexible cord manufacturers, it was deemed advisable to devise ways and means of testing all flexible cord, both pendant and portable, manufactured under the rules of the National Board of Fire Underwriters, as recommended by the Underwriters' National Electrical Association. This is to restrict the introduction into commercial use of any cord which would prove inferior to the National Electrical Code standard, so as to protect reliable manufacturers against inferior goods, in competition. Specifications for these factory tests have been drawn up by the above committee and are as follows: 'Each coil of duplex cord shall be tested dry by the application of 1,500 volts alternating current, simultaneously to each of the two conductors; contact being made on bare copper wires at either end of the coil, and care being taken that the other ends of the conductors do not come together. Alternating current to be supplied from a transformer with an actual working capacity of at least 5 kw.' These factory tests will be conducted in a similar manner to those now carried on under directions of the wire inspection bureau, in the manufacture of National Electrical Code rubber-covered wire.

"Stamps similar to the attached sample will be issued by the wire inspection bureau and sold to the different manufacturers at a charge of 2½ cents per thousand running feet of cord

tested. These stamps are to be attached to the coils of tested cord by the manufacturers themselves, and to serve as a guarantee that cord so stamped has successfully withstood the tests specified by the bureau. They will be furnished for 250-ft., 500-ft. and 1,000-ft. coils, as desired.

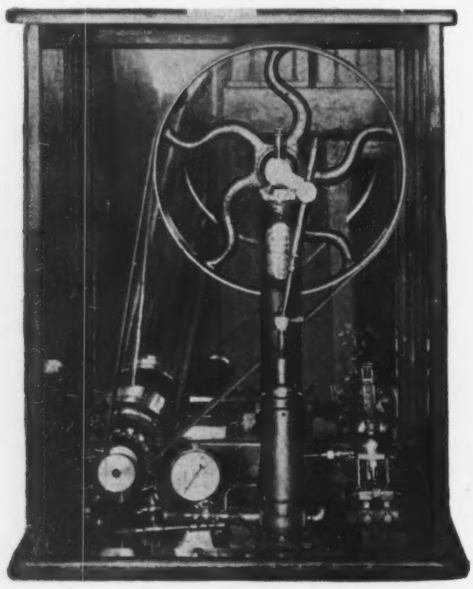
"The majority of flexible cord manufacturers have recently agreed that, on and after March 1, 1907, all National Code cord manufactured by their companies will be made up under the new specifications and duly tested, and will bear identification mark of the wire inspection bureau.

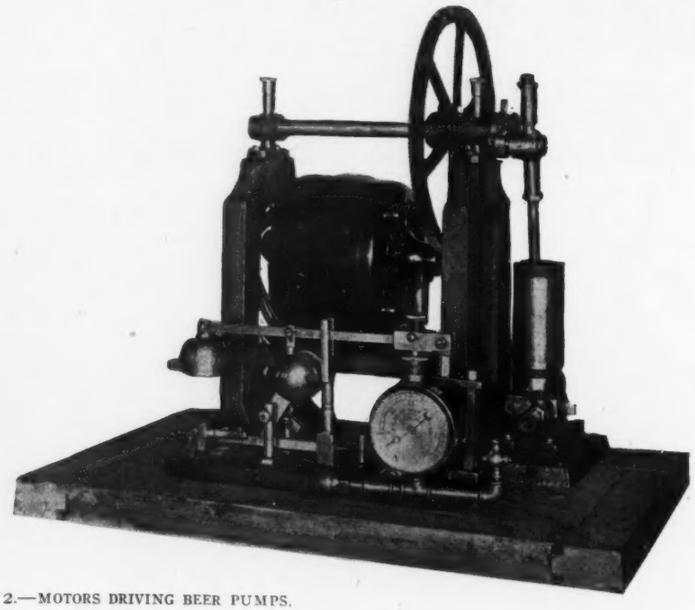
"It is understood that a reasonable time will be allowed, after this date, for the disposal of code cord not bearing the stamp of approval of the wire inspection bureau, on all such cord manufactured before March 1, 1907, and with this understanding the April list of electrical fittings will contain the names of flexible cord manufacturers agreeing to the tests of the wire inspection bureau and using stamps as guarantee that these tests have been properly made.

"No cord will be considered as having been tested which does not carry an identification stamp. Stamps to be securely fastened to the shipping tags attached to the coils. Stamps will have serial numbers and, on coils of less than standard lengths, where stamps specify more cord than coil contains, a credit for excess in stamp value can be obtained from the wire inspection bureau on presentation of the facts in writing, giving size of cord, destination, number of feet and serial number of stamp used. All stamps are to be canceled by manufacturer when used, the date of manufacture of cord, also, being plainly shown."

Motors for Operating Beer Pumps.

In hotels, saloons and breweries there are many applications for small electric motors such as to operate bottle cleaners, automatic air compressors, beer pumps, etc. In Fig. 1 a Westinghouse ⅛-hp motor for alternating-current circuits is shown driving a single-cylinder beer pump, for hotel and saloon use, manufactured by the E. R. Brown Beer Pump Company, of Boston, Mass. A Brown single-cylinder beer pump driven by a similar motor is illustrated in Fig. 2. These motors are compact, neat in appearance and thoroughly reliable in operation. They are built for both alternating and direct-current circuits, either 115 or 230 volts. The direct-current motors are either shunt or series wound and the alternating-current motors are wound for 25, 60 or 133 cycles. The base of the motor consists of separate casting, the frame being drilled and tapped so that the feet may be fastened in any one of four positions adapting them to use on floor, wall or ceiling.





FIGS. 1 AND 2.—MOTORS DRIVING BEER PUMPS.

Variable-Speed Direct-Current Motors.

The accompanying illustrations show a type of motor recently placed on the market by the Allis-Chalmers Company, Milwaukee, Wis., for all classes of work where either a constant-speed or a variable-speed, direct-current motor is required.

In the use of variable-speed motors for the individual drive of machine tools, there are two points to be carefully considered: (1) The size and weight of the motor is dependent to a great extent on the minimum speed at which the motor is required to develop its full rated power; the slower the minimum speed the greater will be the size and weight for a given horse-power output. (2) The maximum speed of the motor is dependent on the peripheral speed of the armature, commutator,

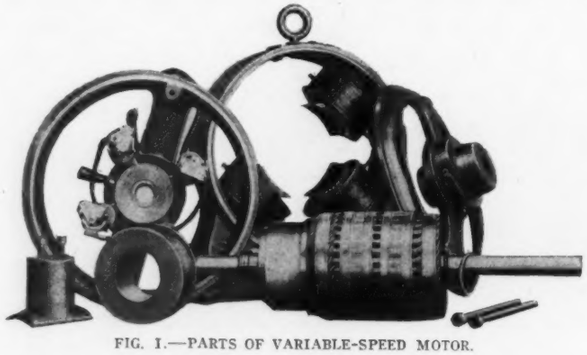


FIG. 1.—PARTS OF VARIABLE-SPEED MOTOR.

pinion or belt; or upon the ratio of speed reduction between the driven shaft and the motor shaft. This limits the maximum speed to from 1,000 to 1,600 r.p.m., depending on the output of the motor. The maximum speed being thus fixed by mechanical limitations, any increase in the range of speed variation must be obtained by decreasing the minimum speed and consequently increasing the size of motor for a given output, or decreasing the output for a given size. These mechanical limitations make it desirable to keep the speed range down to a reasonable amount and the speed in the present line of motors has been limited to a ratio of 1 to 3.

The wide variation solely by shunt field control has required material improvement in commutating qualities. The pole faces have been carefully shaped to give suitable distribution of the field flux. The commutator is of large diameter and ample

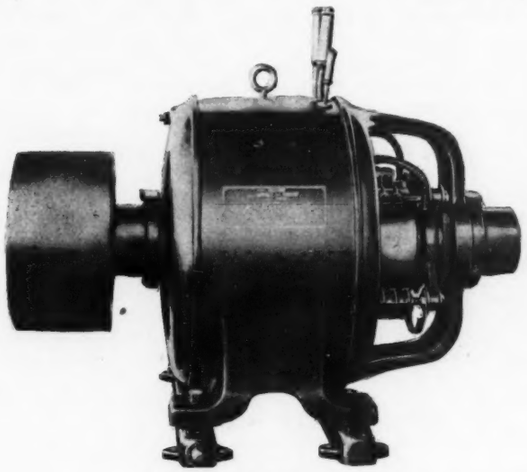
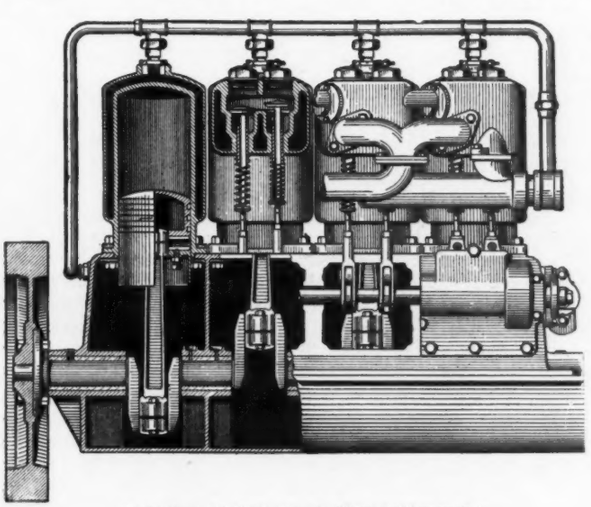


FIG. 2.—MOTOR ASSEMBLED.

wearing depth. The brushes are of graphite and are provided with adequate flexible copper shunts. It is claimed that these machines operate exceptionally well either as generators or motors, and that they will carry their full rated output without sparking.

Jager Direct-Connected Gasoline Engine.

The accompanying figure illustrates clearly the design and general arrangement of the working parts of the Jager four-cylinder, four-cycle engine. The parts are shown in exact proportion to each other and thus represent the actual sizes as accurately as a scale drawing. The liberal size of the crank shaft and bearings to correspond will be noted, and the rigid support of the crank shaft working strains by both parts of the crank case is apparent. The partitions extending across the base castings and the heavy supporting ribs under each main bearing, conduce to a strong construction without excessive weight or



GASOLINE ENGINE FOR DIRECT CONNECTION.

bulk. Rigid support insures permanent alignment and this in turn solves friction and lubrication difficulties most effectively. The end bearings are made especially long because they have more work to do than the other bearings. The flanged support of the fly-wheel is also calculated to relieve crank shaft strain by providing perfect balance permanently maintained.

The engine and dynamo are mounted on one bed plate with a specially designed flexible coupling between the crank shaft and armature shaft, insuring a cushioning effect under sudden shocks incident to electric power service that is especially noticeable in the excellent results obtained under the hardest kind of electric elevator service.

In the design of the engine it will be noted that the valve shaft with its cams and gearing is wholly enclosed in the crank case and is supported in a pair of bearings alongside each group of cams. The connecting rod and crank bearing construction is very strong with exceptionally large bearing areas, but without being unduly heavy. Provision is made for liberal water cooling of the cylinders by extending the water jackets beyond the travel of the head of the piston. The water jacket space around and between the valves is exceptionally large and great care is taken to insure the cooling of the entire area of the valve seats by carrying a wide water port between them. In the Jager design the valves are completely surrounded with water, thus insuring against unequal expansion or distortion of the valve seats.

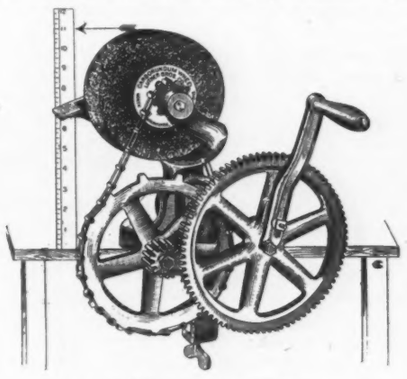
An important point claimed for these engines is that they are not overrated, but capable of continuously developing more than their rated horse-power under brake test in continuous service. In a test by the Bureau of Steam Engineering of the United States Navy a three-cylinder engine rating at 15 hp at 600 r.p.m. developed the following results on four trials: 613 r.p.m. with 17.4 brake hp; 685 r.p.m. with 18.5 brake hp; 691 r.p.m. with 18.55 brake hp; 700 r.p.m. with 19.25 brake hp.

The engines are built in sizes from 3 to 60 hp in 1, 2, 3, 4 and 6 cylinders, and are suitable for direct-connecting to any standard make of generators and are furnished either with or without generator. Either the "jump" or the "make-and-break" ignition eystem is used or both if desired. The governor is of the centrifugal fly-ball type, which operates a sleeve for throttling the mixture. It is very sensitive and regulates the speed of the engine very closely.

In the sizes up to 40 hp the speed is 650 r.p.m., and 550 r.p.m. for the sizes above 40 hp. Fig. 2 shows the 25-hp, four-cylinder engine in operation in the engine room of a large cargo schooner. Two of these sets are in use for operating electric elevators, incandescent lamps, etc.

Hand-Driven Carborundum Grinder.

The machine illustrated herewith is built of malleable iron and steel, and is stated to be fool-proof and capable of withstanding a speed of 5,000 r.p.m. The carborundum wheel does not glaze; it cuts by contact and not by friction. The machine



CARBORUNDUM GRINDER.

has been found very useful by central station companies and electrical contractors on account of its portability. It can be clamped to any convenient bench and thus saves considerable time, which might otherwise be wasted in a trip to the shop. The grinder is sold by the Electric Diamond Machine Company, 123 Liberty Street, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from leading manufacturing centers indicate that scarcely any idle machinery can be found. In some instances business for January at wholesale exceeded that of the same month a year ago, despite interruptions to traffic by heavy snows, rains and floods in various sections. Advance business was most extensive in iron and steel and in the cotton industry, but other prominent producers have liberal contracts on hand also, and the mercantile outlook is bright. For prompt delivery iron and steel manufactures are sold up and finished lines are strong with advancing tendencies, more particularly at the East. All grades of foundry and steel-making iron are scarce for the first and second quarters. Heavy premiums are no bar against the pressing requirements for many kinds of material wanted by makers of heavy machinery and special shapes, castings and forgings for the mining interests and for metal working, locomotive and car-building shops. The heavy rail market is looking up again and the business in light rails is enormous. Local architects and engineers report that contracts for 35,000 tons of structural steel will be closed during the present month. Colder weather and clearance sales have stimulated trade East and North. In the Northwest trade, traffic and collections feel the effects of heavy snowfalls coming on top of an acute car shortage. *Bradstreet's* reports 211 business failures during the week ending January 31, as against 252 the previous week, and 228 in the corresponding week of last year. The international copper markets were very strong. Larger tonnages for home and foreign wants sold at 25¼ to 25½c. for all deliveries to the end of May. It is the opinion that there will be an acute shortage of electrolytic in May, June and July, owing to the large falling off in receipts of metal by electrolytic works that depend upon Western and Southwestern mines affected by storms, washouts and crippled railroads and by smelters short of fuel. The closing quotations are 25c. for lake, 24¾c. for electrolytic and 24⅛c. for casting stock. A Boston dispatch reports the sale of about 1,500,000 lb. of copper mostly for May delivery at 25c. per pound. The best Lake Superior copper is being offered there at 25 to 25½c. per pound. One of the country's largest consumers bought early in the week for February delivery at 25¼c. per pound. This establishes the record price for electrolytic copper.

THE CROCKER-WHEELER JANUARY ORDERS.—The Crocker-Wheeler Company, of Ampere, N. J., reports an excellent opening of business for the new year. Subjoined are some of the January orders: One 1,000-kw frequency changer set for the Pennsylvania Steel Company; twenty-five 230-volt, direct-current motors for the W. & J. Knox Net & Twint Company, Baltimore, a branch of the Barbour Flax Spinning Company, of Paterson, N. J.; one 500-kw, 550-volt railway generator for the Bridgeton Electric Company, Bridgeton, N. J.; one 35-kw, 125-volt, direct-current engine-type generator and fourteen motors from ⅛ to 7½ hp for the Bosch Troy Laundry Company, Austin, Texas; one 300-kw, 575-volt, direct-current, engine-type generator for the Pittsburg & Baltimore Coal Company; seventy-five direct-current mill-type motors for the Alliance Machine Company. These motors are mostly of the new form W type, which has been so well received in the rolling mill business owing to its having been designed specially for that class of service. These motors are to operate cranes, transfer tables, etc., to be built by the Alliance Company for the new plant of the Carnegie Steel Company, at Duquesne, Pa. An order for thirteen 50-hp type W motors is from the Illinois Steel Company for use in operating transfer and roll tables in their plant in South Chicago. Other orders are: One 100-kw, 250-volt engine-type generator for the Lion Brewery, New York; one 50-kw and one 35-kw, direct-current generators and ten motors for the Dixey Brewery Company, New Orleans; two 560-kilovolt-amp., 25-cycle, 6,600-volt, single-phase, alternating-current generators for the Charleston & Summerville Street Railway Company, Charleston, S. C., to be driven by "Snow" gas engines; two 75-kw, engine-type, alternating-current generators for the American Biscuit Company, San Francisco; one 160-kw, synchronous motor-generator set for the Illinois Steel Company, to be installed at South Chicago; one 200-kw and one 90-kw, 250-volt, direct-current, engine-type generator for the Bridgeport Malleable Iron Company; one 225-kw, 250-volt, direct-current engine-type generator for the Eaton, Cole & Burnham Company, Bridgeport, Conn.; two 150-kilovolt-amp., 60-cycle, 2,300-volt, synchronous motors for the Solvay Process Company, Syracuse, N. Y.; two 150-hp and one 175-hp, 230-volt, slow-speed, direct-current motors for the National Tube Company, McKeesport, Pa.

CUMBERLAND WATER POWER.—It is stated that an enterprise that promises to absorb three or four millions of capital and to turn it into a condition of high productivity, is now engaging the attention of several New Yorkers and their associates in Boston and Philadelphia. It is the development of about 20,000 hp on the Cumberland River, Ky., at the 65-ft. fall, about 25 miles below Williamsburg, and the utilization of this power in the shape of electricity in the production of aluminum. The enterprise involves the construction of a dam, which will back the water at that point about 26 miles. This will give a water storage ample to provide 20,000 hp at any season of the year. The river itself is fed from sources in the mountains and so is not dependent upon forest conditions. The power house will probably include four or five turbines and sets of generators with a capacity of about 5,000 hp each. The especial reasons for the choice of location of this plant are several, aside from the excellence of the water power to be developed. The deposits of bauxite are extensive and conveniently accessible at this point; the Queen & Crescent and the Louisville & Nashville Railroads are convenient for shipment, and the location is within 70 to 100 miles of four cities, including Louisville and Knoxville, that are in the market for any surplus electrical energy which the power plant may have to dispose of, while it is but 150 miles to Cincinnati. The promoters include Wm. F. Cox and his associates of New York City, J. J. Wetmore, of Philadelphia; S. L. Merchant, of Boston, and others, are modest in announcing their expectations, it is easy to see why millions should be justified in an enterprise for increasing the supply of aluminum at this time.

APPARATUS WANTED.—The Broken Arrow Electric Light & Power Company, of Broken Arrow, Ind. Ter., is in the market for electric flatirons and similar current consuming devices. The irons should be in lots of 100 and those are preferred in which the heating element can be changed. Catalogues and price lists should be sent. The company also wishes to receive catalogues of alternating-current fans for desk and ceiling, for 110 and 220 volts, 60 cycles. Prices and discounts should be quoted. Mr. J. H. Rhyne is president of the company, Mr. R. C. Rhyne vice-president and treasurer, and Mr. C. E. Blake, electrician and secretary.

SUNBEAM TUNGSTEN LAMPS.—Experiments are now being conducted by the engineering department of the Sunbeam Incandescent Lamp Company, on tungsten metallic filaments, and as a result of recent developments the Western Electric Company reports that it will, no doubt, be among the first of the companies which will be in position to furnish these lamps to the trade. This is an 80-cp lamp with a total wattage of 100, or 1¼ watts per candle-power. The lamp is not yet offered for sale.

DODGE & DAY, engineers, of Philadelphia, are building the new shops for the Jones & Lamson Machine Company, at Springfield, Vt. The work is being pushed as rapidly as possible and the order for the steel has already been placed. The new building for the Bridgeport Brass Company, which is being engineered and constructed by Dodge & Day, is well under way, the steel having been ordered, and the foundation work nearly completed.

INDUCTION MOTORS IN PAINT MILL.—Not long since the Wadsworth-Howland Company, of Chicago, paint manufacturers, burned out and, instead of rebuilding purchased the paint works of the Geo. W. Pitkin Company, which were being

equipped with Allis-Chalmers induction motors of the latest type. The entire induction motor equipment aggregating 300 hp was placed with the Allis-Chalmers Company. The power installation is entirely electrical, including electric lighting, the underwriters allowing no gas or burning of oil in the building. 30-hp motors will drive six lead mixers, 10-hp motors will drive the white lead and putty chasers, three motors being used on tandem mills, 5-hp motors will be used on sampling mills and others will be used for driving 20-in. water-cooled mills.

Financial Intelligence.

THE WEEK IN WALL STREET.—Activity on the stock market was restricted and highly professional, and prices were irregular and unsteady. The favorable quarterly report of the United States Steel Corporation had little effect in the market, notwithstanding that it exceeds all records as to the magnitude of earnings. Steel stocks were comparatively steady, but no speculative interest developed in them. Prices for a good many of the standard stocks reached a level at which such securities

NEW YORK

	Jan. 29	Feb. 5		Jan. 29	Feb. 5
Allis-Chalmers Co.	14¾	14¼	General Electric	158	157
Allis-Chalmers Co. pfd.	37	36	Hudson River Tel	...	...
American Dist. Tel	...	...	Interborough Met. Com.	34¾	35⅛
American Locomotive	71⅛	71⅛	Interborough Met. pfd.	71¾	71¼
American Locomotive pfd.	111	110	Mackay Cos.	...	...
American Tel. & Cable	83	83	Mackay Cos. pfd.	...	...
American Tel & Tel.	...	...	Marconi Tel	...	...
Brooklyn Rapid Transit	73¾	73⅛	Metropolitan St. Ry.	...	...
Electric Boat	31	31	N. Y. & N. J. Tel.	...	...
Electric Boat pfd.	73	73	Western Union Tel.	83	82⅜
Electric Vehicle	...	...	Westinghouse com.	150	150
Electric Vehicle pfd	...	...	Westinghouse pfd.	...	...

BOSTON

	Jan 29	Feb. 5		Jan. 22	Feb. 5
American Tel & Tel.	128	129	Mass. Elec. Ry. pfd	69¼	69
Cumberland Telephone	110¼	...	Mexican Telephone	...	...
Edison Elec. Illum.	227½	228	New England Telephone	120¼	121
General Electric	...	...	Western Tel. & Tel.	8½	...
Mass. Elec. Ry.	19½	19	Western Tel. & Tel. pfd.	78	...

PHILADELPHIA

	Jan. 29	Feb. 5		Jan. 29	Feb. 5
American Railways	50½	50¼	Phila. Electric	7⅞	7¼
Elec. Co. of America	10¾	10⅝	Phila. Rapid Trans	21¼	20⅝
Elec. Storage Battery	65	63	Phila. Traction	95	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Jan. 29	Feb. 5		Jan. 29	Feb. 5
Chicago City Ry.	... 150	150	National Carbon	80	78
Chicago Edison	140	140	National Carbon pfd.	117	117
Chicago Subway	38	30½	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	26¼	26¼			

*Ex-dividend

were attractive to conservative investors and considerable buying of that kind was in evidence. On Thursday there was a rather brisk rally and a recovery from the quotations made early in the week, which in a good many instances had been the lowest since January 1. At the end of the week there was a renewed selling movement and farther declines throughout the list. All of the electric and traction stocks were weak and prices declined. American Telephone & Telegraph lost 5 points on the week's business, closing at 128. On the curb the week was devoted chiefly to liquidation with much pressure in the mining group. In point of decline Standard Oil and Chicago Subway were the features. The 15-point collapse in Chicago Subway was apparently attended with heavy liquidation by the pool, which withdrew all support. Above are the closing quotations of February 5.

BELL TELEPHONE BONDS.—The announcement is made that the subscription lists for $40,000,000 American Telephone & Telegraph Company's convertible 4 per cent bonds will be opened on February 5 at the offices of J. P. Morgan & Co., and Kuhn, Loeb & Co., of New York, and Kidder, Peabody & Co., of Boston. A simultaneous issue of the bonds will be made by Baring Bros. & Co. and J. S. Morgan & Co., in London, and Hope & Co., in Amsterdam. The subscription price is 92½ and accrued interest. The terms of subscription are $50 on each bond on application, $50 on allotment and the balance and accrued interest on or before March 28. The subscription lists will close at or before 3 p.m. on the day that they are opened. In making allotments under the subscriptions preference is to be accorded to shareholders of the company to the extent of 20 per cent of their holdings. These bonds are parts of an issue of $150,000,000, all or part of which are redeemable at the option of the company at 105 and interest on or before March 1, 1914. They are convertible at par at the option of the holder into common stock at $140 per share after March 1, 1909, and before March 1, 1918, and in the meantime up to 30 days prior to the date of redemption named in any redemption call. It is provided, also, that if additional stock is issued or sold at a price averaging less than $140 per share, bondholders will have the benefit of a reduced conversion price.

LANCASTER PROPERTIES SOLD.—Steps have been taken toward the acquirement of existing electric railway systems necessary to a complete line between New York City and Philadelphia in the consummation on January 25 at Lancaster of a deal transferring the electric railway and lighting properties of the Lancaster County Railway & Light Company to interests closely identified with the McCall Ferry Power Company and the Pennsylvania Railroad Company. The name of the new company will be the Susquehanna Railway & Light Company. The firm that financed the deal are Bertron, Starrs & Griscom, bankers of New York, and financial agents for the McCall Ferry Power Company. At a meeting, January 25, of the stockholders of the Lancaster County Railway & Light Company, which operates practically all of the trolley lines in Lancaster County, lights Lancaster and Columbia, and furnishes all the electric heat and power used in that county, it was unanimously agreed to accept the New York firm's offer of $100 per share for the common stock, 20,000 shares of which are outstanding, the par value being $50, with the alternative offer of preferred stock in a new company that will be organized, with a bonus of common stock. This would mean about $2,000,000, although the preferred may be taken in many instances.

ECONOMIC POWER COMPANY.—The Economic Power & Construction Company, of Albany, N. Y., has filed in the County Clerk's office a mortgage to the New York Security Company for $250,000 on its franchise and property. It is announced that the company intends to construct and operate plants in Buffalo, Rochester, Syracuse, Utica, Schenectady, Troy, Albany, Yonkers and New York City. The announcement of the mortgage attracted considerable attention, as foreshadowing an extensive power distribution, possibly from Niagara Falls. The charter was obtained some years ago by incorporators, including George Curtis Treadwell, now military secretary to Governor Hughes, and ex-Mayor John Boyd Thacher. William K. McFarland is now president and Burt L. Jones secretary.

AMERICAN TELEGRAPHONE.—At the annual meeting of the American Telegraphone Company held in Washington last week the president reported the company free from debt and with resources ample for factory developments now contemplated and also for future requirements. He reported that new machinery contracted for is being installed. The management expects the output of new instruments will soon be sufficient to supply the many calls and orders already received, which have heretofore been held in abeyance awaiting the perfection of the new type of instrument.

DIVIDENDS.—The Electric Properties Company has declared a dividend at the rate of 6 per cent. per annum to January 31, 1907, from the date of the last dividend, September 30, 1906, payable February 7, on the preferred stock. The directors of the New York & Queens Electric Power Co. have declared a semi-annual dividend of 2½ per cent. on the preferred stock, payable February 11. Directors of the Metropolitan Elevated Co. have declared a quarterly dividend of ¾ of 1 per cent. on the preferred stock, payable March 30. This is the first dividend since February, 1903.

SAN FRANCISCO COKE & GAS COMPANY.—At a recent meeting of the directors of the San Francisco Coke & Gas Company it was decided to increase the capital stock of the company from $5,000,000 to $10,000,000, and also to increase the bonded indebtedness of the company from $2,500,000 to $7,500,000. The company is planning to extend its mains, gas plant and also to install an electric plant to manufacture and furnish electricity in San Francisco. Leopold Michels is president.

APPLEYARD TRACTION SALVAGE.—It is announced from Cincinnati that the various Appleyard traction lines, which were sold some months ago, have passed from under the control of the courts. The final disposition of the properties has been made and the purchase money has been ordered paid to the creditors. The latter got dividends ranging from 3 to 10 per cent.

GENERAL NEWS.

Construction News.

SHEFFIELD, ALA.—A Westinghouse Parsons turbine of 120 hp is being installed in the plant of the Sheffield Company.

DES ARC, ARK.—The Planters' Cotton Oil Company is now installing a 45-kw, 125-volt General Electric generator in its plant. W. C. Pearce is manager.

FORDYCE, ARK.—The Fordyce Light & Water Company is increasing the capacity of its plant by the installation of an additional unit consisting of a 75-hp Hamilton Corliss engine and a 50-kw, 2,200-volt, single-phase Westinghouse generator. Elmer L. Dunn is manager.

LITTLE ROCK, ARK.—The Little Rock Railway & Electric Company has placed a contract with the General Electric Company for a 1,500-kw Curtis steam turbine. D. A. Hegarty is manager.

POCAHONTAS, ARK.—The Pocahontas Ice & Power Company will make some extensions and improvements to its plant in the near future. O. A. Gafford is manager.

ALAMEDA, CAL.—The City Council recently reduced the rate for electricity supplied to private consumers from 10 cents to 7 cents per kw-hour, with a minimum charge of $1.00 per month. The rate to the city itself was reduced from 6¼ to 4½ cents.

HUNTINGTON PARK, CAL.—The citizens have authorized the Board of Trustees to call an election to vote on the question of issuing $20,000 in bonds for the purpose of installing a municipal lighting plant.

LAKEPORT, CAL.—The City Council has granted a franchise to the Lake County Electric Power Company to install an electric lighting and power system within the town limits. G. W. Scott and W. W. Van Arsdale and Theodore A. Bell are the principal stockholders of the company, which was organized for the purpose of distributing electricity throughout Lake County. It will receive electricity from the plant of the Snow Mountain Power and Water Company, which is in course of construction on Eel River. It is the intention of the company to have its lighting system in operation by next October.

LOS ANGELES, CAL.—The Los Angeles-Pacific Railway Company has been granted permission to build a subway in this city. The project as now contemplated involves an expenditure of $5,000,000. It is stated that work will commence in less than 90 days and will be completed within two years.

MONTEREY, CAL.—It is reported that the Monterey County Gas & Electric Company intends to install a complete new plant in its power house in this city.

SAN FRANCISCO, CAL.—The directors of the San Francisco Coke & Gas Company have decided to increase the capital stock of the company from $5,000,000 to $10,000,000, and also to increase the bonded indebtedness of the company from $2,500,000 to $7,500,000. President Leopold Michels of the company, states that the directors recommended such action to enable the company to extend its mains, the gas plant, and also to install a plant to manufacture and furnish electricity throughout San Francisco.

SAN FRANCISCO, CAL.—To prevent its business becoming confused with that of the San Francisco Gas & Electric Company, the San Francisco Coke & Gas Company has filed an application to change its name to the Metropolitan Light & Power Company.

SAN FRANCISCO, CAL.—The Stanislaus Electric Power Company has contracted for a new equipment for its new power plant located at Stanislaus, about 30 miles northeast of Sonora, which will have a capacity of over 36,000 hp. A large dam will be erected in Relief Valley, which will have a capacity of over 1,000,000,000 gallons.

SANTA CRUZ, CAL.—The City Council has granted a franchise to the Union Traction Company, which will enable the company to rebuild its system in this city. The company will double track, modernize and convert its system to standard gauge.

GEORGETOWN, COL.—The Two American Sisters Mining, Milling, Power & Electric Company has made application to the Board of Selectmen for a franchise to supply electricity for lighting and power in the Georgetown district. The company is erecting a plant, which is nearly completed two miles below Georgetown. J. J. White is manager.

HARTFORD, CONN.—The Hartford Electric Light Company has petitioned the State Legislature for an amendment to its charter, giving it power to increase its capital stock and to acquire stock, property and franchises of other electric lighting corporations.

NEW CANAAN, CONN.—Harold H. Mead and Harold S. Demerrit are considering the matter of establishing an electric light plant. Plans have been made for a plant and estimates secured as to the cost of the entire system.

NORWICH, CONN.—The Uncas Power Company has been organized for the purpose of furnishing electricity in Norwich. The capital stock of the company is to be $150,000, and Charles W. Comstock has been elected president; Costello Leppitt, treasurer, and John D. Hall, secretary. The company has bought up the water power privilege of the Schtucket River, between South Windham and Scotland, of the Baltic Power Company, and proposes to begin work in the spring. A dam will be built about three miles southeast of South Windham. A power station will be built in South Windham capable of generating 2,000 hp at a cost of about $200,000.

PUTNAM, CONN.—The Putnam Light & Power Company is contemplating installing a new engine and generator in its plant in the spring. A. W. Bowen is manager.

GEORGETOWN, DEL.—L. D. Shank, manager of the Georgetown Light, Heat & Power Company, writes that this company will soon be in the market for 20 miles of wire, and transformers.

WASHINGTON, D. C.—Bids will be received at the office of the Building Committee U. S. Department of Agriculture (B. T. Galloway, chairman) until Mar. 12, for the construction of a power house.

WASHINGTON, D. C.—The Potomac Electric Company has announced that it will shortly place its wires in underground conduits on Connecticut Avenue and Calvert Street from the bridge over Rock Creek to Cathedral Avenue. Prompted by this announcement the District Commissioners have decided to ask the Capital Traction Company to extend its underground system from the present terminus at the "loop" at the east end of Rock Creek bridge to the entrance of Cleveland Park.

ELBUM, ILL.—At an election held recently the citizens voted to issue $5,000 in bonds for the purpose of installing an electric light plant.

WASHINGTON, D. C.—Bids will be received until Feb. 25 by Lieut. J. H. Poole, Corps of Engineers, U. S. A., superintendent, State, War and Navy Department Building, Washington, D. C., for renewing portions of the heating, lighting and power plant of this building. The work will consist of furnishing and installing three boilers, two elevator pumps, and a complete system for heating the water of the present hot water heating system by exhaust and live steam, together with all piping, tanks, fittings and auxiliaries for the boilers, pumping system and heating system. Plans and specifications may be had upon a deposit of $25.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 19, to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies as follows: Schedule 386—voltmeters, wattmeters, etc. Schedule 387—motors, etc. Also until Feb. 26 to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va.; Charleston, S. C., and Port Royal, S. C., a quantity of naval supplies, as follows: Schedule 389—incandescent lamps, etc. Schedule 390—spare parts for arc lamps, conductor, dry cells, insulators, etc. Schedule 391—arc lamps, wire, conduit, cable, cross arms, etc., cells, electrical supplies, copper gaskets, etc. Schedule 392—cable terminals, conduit fittings, electrical supplies, etc. Schedule 393—portable electric grinders, steam pumps, feed pumps, test pump, flexible copper tubing, brass and copper tubing, etc. Also until Feb. 26, to furnish at the navy yard, Pensacola, Fla., and the naval stations at Key West, Fla., and New Orleans, La., a quantity of naval supplies, as follows: Schedule 399—electrical supplies, ingot copper, brass tubing, etc. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster-General, U. S. N.

ARCADIA, FLA.—The Arcadia Electric Light, Ice & Telephone Company is contemplating installing a series arc circuit. Edmond Scott is manager.

JACKSONVILLE, FLA.—Extensive improvements and additions are contemplated to the municipal electric light plant, which consists of the installation of two 500-hp boilers, a new chimney and the construction of a 125 ft. dam. R. N. Ellis is superintendent.

BAINBRIDGE, GA.—The managers of the municipal electric light plant are preparing to establish a day service and are now installing a 108-kw, two-phase, alternating-current Stanley generator and a 25-hp Corliss engine.

CORDELE, GA.—The Citizens' Electric Light & Power Company is contemplating establishing a day service.

ELBERTON, GA.—Plans are being made to install an additional engine of 125 hp and an alternator in the municipal electric light plant. G. W. Hubbard is superintendent.

THOMASVILLE, GA.—The citizens are contemplating the installation of a 60-cycle, three-phase, direct-connected unit in the municipal electric light plant. D. R. Pringle is superintendent.

CARTHAGE, ILL.—The Mississippi Valley Telephone Company has increased its capital stock from $50,000 to $100,000.

CHICAGO, ILL.—Separate bids will be received until Feb. 20 by the South Park Commissioners, E. G. Shumway, secretary, for furnishing, delivering and erecting in the power house in Washington Park, the following: One centrifugal pump, capacity 5,000 gallons per minute; one surface condenser for a 1,000-kw steam turbine; one open type feed water

heater having a capacity of 1,000 hp.; sheet steel breeching for 3,350 hp boilers; non-conducting fireproof breeching lining for 3,350 hp boilers; one 50-kw, 125-volt, direct-current generator; one 50-hp vertical throttling engine; one 90-hp vertical automatic engine; one boiler feed pump, 200 gallons per minute; one 20-ton traveling bridge crane.

FARMINGTON, ILL.—The Farmington Electric Light Company will soon install an Ide engine and a 90-kw alternator, which it expects to have in operation in 60 or 90 days. The alternator has not yet been selected. Theodore Bass is owner.

HARVARD, ILL.—The Joyce & Condon Electric Company has purchased the municipal electric lighting plant and the plant of the F. L. Smith Electric Company in this city. It is said that an entirely new service will be installed.

JOHNSON CITY, ILL.—Extensive improvements and additions are contemplated by the Johnson City Electric, Gas & Water Company, among which are the construction of a building 50x80 ft., installing a two million gallon pressure pumps, ten artesian wells, construction of reservoir and extension of water mains, etc. Frank Bartines is manager.

LEWISTON, ILL.—The Fisher Power, Heat & Electric Light Company is contemplating making improvements to its plant providing for an all-night service and may install a day service. E. E. Butterfield is general manager.

LITCHFIELD, ILL.—The Litchfield Gas & Electric Company is making plans for the installation of a boiler from 200 to 250-hp capacity, 100-hp engine, a 150-kw, alternating-current, two-phase generator, series alternating-current lighting system and 80 enclosed arc lamps of 2,000 cp, with regulators and transformers. D. Davis is manager.

CONNERSVILLE, IND.—A franchise has been granted to the Connersville Street Railway Company. R. Neil Burgess is vice-president.

INDIANAPOLIS, IND.—The sale of the Northern Indiana Railway Company, consisting of the traction lines between Goshen and South Bend and between La Porte and Michigan City, as well as the street railway systems of South Bend, Goshen, Elkhart, Mishawaka, La Porte and Michigan City, has been announced. The properties have been purchased by the Dietrich-Murdock syndicate from Arthur Kennedy, of New York, N. Y., and his Pittsburg, Pa., associates for $4,000,000. A company has been incorporated under the laws of Indiana, for $7,500,000, under the title of the Chicago, South Bend & Northern Indiana Railway Company. It is the intention of the new company to build at once a line from South Bend to Chicago by the way of Michigan City.

JASONVILLE, IND.—H. L. Hyatt, manager Jasonville Electric Company, writes that it is proposed to construct an electric light plant.

LAPORTE, IND.—The Chicago, South Bend & Northern Indiana Railway Company, recently incorporated to take over the Northern Railway Company, has executed a trust deed to the Central Trust Company, of New York, N. Y., of $5,000,000. The proceeds of which will be used for completing connecting lines of the system; for the erection of a large central power plant, and to take up outstanding bonds of the company.

NEW CASTLE, IND.—Ambros Pelty, of Detroit, has purchased the local light, heat and power plant, and is now reorganizing the company, after which extensive improvements will be made. The service will be extended, and the entire city will be rewired.

TERRE HAUTE, IND.—Acting on the report of Prof. Thomas Gray, of Rose Polytechnic Institute, the Board of Public Works has contracted with the Terre Haute Traction & Light Company for the installation of new street lamps. The present arc lamps now in use will be replaced by the luminous arc lamps. C. T. Murdock, manager of the Terre Haute Traction & Light Company states that orders have already been placed for the lamps and that the new system can be installed by April 1.

CEDAR RAPIDS, IA.—Wm. L. Dows is reported to have petitioned the Council for a franchise for a lighting plant.

DUNCOMBE, IA.—The citizens of this village are considering the proposition of establishing a municipal electric lighting system.

FORT DODGE, IA.—Prof. S. W. Beyer, of Ames, will prepare an estimate of cost for the construction of a concrete dam for developing electric power from Des Moines River.

KEOKUK, IA.—It is reported that agreements have been reached between the company of which Hugh L. Cooper is engineer and which intends constructing a dam at Keokuk and the War Department at Washington, whereby the dam is to be constructed. It is stated that about $10,000,000 will be expended.

MARSHALLTOWN, IA.—The citizens of Marshalltown have voted a three per cent. tax to aid the Marshalltown Electric Street Interurban Railway Company in building an interurban railway from Marshalltown to Melbourne. The company proposes to locate its power plant, car barns and machine shop in this place.

MOUNT AYR, IA.—The question of constructing a municipal electric light plant may be submitted to the voters in the spring.

SIOUX CITY, IA.—The City Council has passed an ordinance requiring the electric wires within a certain district to be placed in underground conduits.

VINTON, IA.—Engineer Tschirgi, who was commissioned by the City Council to look into the feasibility of constructing a hydro-electric plant on the Cedar River near Vinton, states that a plant having a capacity of about 900 hp can be erected at an estimated cost of about $92,000.

BAXTER SPRINGS, KAN.—J. B. Lucas, manager of the Spring River Power Company, is making a survey on Spring River east of the Omaha mines for the building of a water power plant. It is proposed to install a hydro-electric plant for the purpose of furnishing electricity for light and power to the mines of Baxter Springs.

GOODLAND, KAN.—An appropriation of $5,500 has been made by the Rock Island system to put in an electric light plant at the yards in the spring.

PARSONS, KAN.—An ordinance is now before the Council, granting Jasper E. Brady, of Chicago, Ill., a franchise to construct and operate an electric light plant.

TOPEKA, KAN.—The Stranger Valley Electric Railway Company has purchased the right of way for an electric railway from Kansas City to Tonganoxie. W. Laming, of Tonganoxie, is chief promoter of the project.

COVINGTON, KY.—The first definite step toward the erection of a municipal electric lighting plant has been taken by the Board of Council by appropriating $20,000 from taxes to be applied to the payment of the plant. The ordinance contained a provision that all of the receipts from the sale of the $75,000 of municipal light plant bonds and $20,000 from taxes should be used in constructing a plant to light the streets, alleys and public buildings of the city, and also setting aside $6,750 to pay interest on the bonds. It is estimated that the plant will cost about $106,000 when completed.

LOUISVILLE, KY.—Arrangements are being made by the Board of Public Works for the installation of about 400 new arc lamps to take the place of a like number already in use. Before the close of the present year it is expected that the Board of Public Works will put up about 400 additional arc lamps. At present, there are about 2,000 arc lamps in use on the streets.

BELFAST, ME.—The Belfast Gas & Electric Company will make extensive repairs and additions to its plant. A waterwheel capable of 200 hp capacity will be installed in April and a new boiler has been ordered. The company owns the water privilege of Hiram Dale's falls, a short distance above the present plant and is intending to develop it. A new generator for the station is also being negotiated for. Claude B. Roberts is interested.

BALTIMORE, MD.—The Roland Park Electric & Water Company has been merged with the Consolidated Gas Electric Light & Power Company of this city. Under the agreement of sale the Roland Park Company retains the water plant used in connection with its suburban development and will continue to operate it. By agreement the Consolidated Company will extend its service, both gas and electric, to all future improvements on the lands of the Roland Park Company. The Consolidated Company is also to have the exclusive right to furnish such service on the property owned by the land company.

SPRINGFIELD, MD.—The managers of the Springfield State Hospital for the Insane are considering the construction of an electric railway from Sykesville to the hospital. Dr. Clarke is superintendent.

LYNN, MASS.—The Council has voted in favor of appointing a committee to consider the advisability of establishing a municipal lighting plant.

PROVINCETOWN, MASS.—At the annual meeting of the Cape Light, Heat & Power Company the directors voted to purchase a new engine to replace the old one and other improvements to be made in the spring.

COLDWATER, MICH.—At the annual meeting of the Southern Michigan Telephone Company, held recently, the capital stock was increased from $300,000 to $1,000,000. The increase over and above $300,000 is to be held as treasury stock, and the proceeds from the same to be used for improvements and extensions of the system in this city and elsewhere. The old board of directors was re-elected, consisting of A. C. Himebaugh, president; Charles A. Sturgis, R. L. Himebaugh, T. A. Hilton, George S. Sheffield and R. C. Himebaugh.

BAY CITY, MICH.—The Midland Electric Light & Power Company is prepared to submit to the City Council a proposition to light the city with arc lamps at the rate of $48 per lamp per year.

MANCHESTER, MICH.—The installation of a municipal lighting plant is under discussion.

PONTIAC, MICH.—The Oakland County Telephone Company has been reorganized and articles of association have been filed with the county clerk with a capital stock of $500,000. G. C. Himebaugh is president.

VANDERBILT, MICH.—The village has granted a franchise to the Parks & Keller Shingle Company to light the village streets for a period of 10 years.

WYANDOTTE, MICH.—The citizens are considering the proposition to issue bonds for the purpose of increasing the capacity of the municipal electric light plant.

CROOKSTON, MINN.—The Crookston Water Works, Power & Light Company is contemplating the construction of a power plant and dam. W. J. Murphy, of Minneapolis, is president.

DAWSON, MINN.—The City Council is considering the construction of an electric light plant.

FERGUS FALLS, MINN.—A. Brandenbury, chairman Electric Light Committee, writes that R. S. Fourtado, of Chicago, Ill., is making plans and specifications for the proposed dam for power purposes, to cost between $40,000 and $60,000.

MANKATO, MINN.—The Lakeview Telephone Company has been organized and W. Tarno elected president.

ROCHESTER, MINN.—The Rochester Telephone Company will erect a new telephone exchange in this city at a cost of about $25,000.

SAUK RAPIDS, MINN.—The people of this city are planning to establish a lighting system of their own.

BELLEVILLE, MO.—The members of the Rural Telephone Company have decided to dissolve the organization and form a new company under the name of the Grantfork Mutual Telephone Company. Joseph Cruenfelder and J. S. Leaf are interested in the project.

ST. LOUIS, MO.—A permit has been issued to the St. Louis Sash & Door Company for alterations and additions to its power house at 3414 North Broadway, to cost $2,500.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has petitioned the Legislature for authority to sell electricity for light, heat and power along its lines. A number of farmers are considering the installation of motors for operating machinery on their farms.

ORD, NEB.—The Ord Electric Light & Power Company has been incorporated with a capital of $20,000.

CONCORD, N. H.—An effort is being made before the Legislature to secure the passage of a bill to discontinue the Hudson, Pelham & Salem Electric Railway, between Pelham, N. H., and Methuen, Mass.

GARWOOD, N. J.—The Hall Signal Company is contemplating making extensive improvements to its factory at an expenditure of about $1,000,000, which will include, besides the equipping of the plant with electrical machinery the building of a power house for the purpose of supplying electricity for operating the machines in the different buildings.

WOODBURY, N. J.—The City Council has appointed a special committee consisting of M. F. Cattell, chairman; C. Walters Shivers and A. T. Matlack, to make investigation concerning the cost of an electric lighting system.

ALBANY, N. Y.—The Economic Power & Construction Company has filed a mortgage for $250,000, and it is announced that the company intends to construct and operate plants in Buffalo, Rochester, Syracuse, Utica, Troy, Albany, Yonkers and New York City. William K. McFarland is president of the company.

EAST CREEK, N. Y.—The report published in a number of papers recently to the effect that the East Creek Electric Light & Power Company has been sold to the interests controlling the Fonda, Johnstown & Gloversville Electric Railroad is emphatically denied by G. R. Beardslee, who pronounces it without foundation. Mr. Beardslee, it is understood, expects to develop the power on the East Canada Creek at Ingham's Mills during the coming summer, and to extend his lines down the valley to the Tribe's Hill plant of the Fonda, Johnstown & Gloversville road, where he will use his surplus power to furnish electricity for the railroad, which has a steam plant at the point mentioned.

GENEVA, N. Y.—The Geneva, Phelps & Newark Company has been granted permission by the State Board of Railroad Commissioners to issue a first mortgage for $700,000 on the condition that only $550,000 bonds be issued under this consent, and that before the additional $150,000 bonds shall be issued the consent of the board shall be obtained. This road was recently granted a certificate of necessity to build an electric road from Geneva to Newark, a distance of 15 miles.

OGDENSBURG, N. Y.—The Ogdensburg Street Railway Company is contemplating the extension of its lines from this city through Heuvelton, Rensselear Falls and De Kalb to Canton, energy for operating the line to be obtained from the power plant at Hannawa Falls.

SYRACUSE, N. Y.—The City Council has adopted a resolution to authorize Mayor Alan C. Fobes to appoint a commission of seven members to investigate the lighting situation with a view of benefitting the consumers of gas and electricity. The members of the commission are as follows: William H. Warner, Charles W. Snow, Adam Volles, John H. Barr, George W. Driscoll, Peter Eckel and John A. Mathews.

WEST POINT, N. Y.—Maj. J. M. Carson, Jr., Quartermaster, U. S. A., writes that the contract for constructing an electric subway system at West Point has been awarded to Russel Constructing Company, of New York City, for $64,371.

LEAKSVILLE, N. C.—J. C. and E. B. King propose erecting an electric light and power plant here, to cost between $12,000 and $15,000.

WILMINGTON, N. C.—Application will soon be made for a charter for the People's Electric Light & Supply Company of this city. The company, it is stated, will be capitalized at $100,000, and the promoters are J. O. Brock, T. W. Wood and others.

BISMARCK, N. D.—Extensive improvements are contemplated by the North Dakota Independent Telephone Company, recently organized and already doing business over 2,200 miles of long-distance lines. A new station is to be built at Bismarck, and close to half a million dollars will be spent in extending the service during the coming year. H. R. Lyon is president.

AKRON, OHIO.—Work will commence early in the spring on the construction of the Massillon & Akron Electric Street Railway. W. S Mitchell, of Barberton, is general manager.

ASHLAND, OHIO.—A petition has been filed in the common pleas court praying that the Ashland Gas & Electric Light Company be dissolved, the property sold, debts paid and the balance, if any, divided among the stockholders.

ATHENS, OHIO.—Arrangements have been made by the City Council for the issue of $6,000 in bonds to be used for new equipment for the electric light plant.

CLEVELAND, OHIO.—The Council has passed an ordinance authorizing the Board of Public Service to spend $40,000 for lighting supplies.

COLLINWOOD, OHIO.—The Village Council is considering the question of issuing about $25,000 bonds, to increase the capacity of the electric light plant.

DAYTON, OHIO.—At the annual meeting of the Oakwood Street Railway Company held Jan. 14 the stockholders authorized the president to negotiate for improvements contemplated by the company in the near future, among which are the purchase of an additional unit consisting of an engine and generator.

DEFIANCE, OHIO.—The Auglaize Power Company will construct a hydro-electric power plant near here. H. von Schon is consulting engineer, of Detroit, Mich.

LAKEWOOD, OHIO.—Sealed bids will be received by the clerk of the Board of Trustees of Public Affairs until Feb. 16, for the purchase of the electric light plant. E. E. Sherwood is president of the board.

LIMA, OHIO.—Plans and specifications have been completed for the new exchange building which the Central Union Telephone Company is to erect in this city. The building and equipment will cost about $25,000.

MARTINS FERRY, OHIO.—Work will soon be commenced by the Dillonvale & Ohio River Traction Company on the construction of the line to be built from Rayland to Dillonvale, a distance of six miles. W. B. Francis is secretary.

MOUNT OREB, OHIO.—The capital stock of the Mount Oreb Telephone Company has been increased from $10,000 to $20,000.

MT. VICTORY, OHIO.—The electric light plant in this place has been purchased by Henry Conklin, of Kenton, Ohio.

SPRINGFIELD, OHIO.—J. B. Cahoon, vice-president of the Eldenbel Construction Company, of New York City, has announced that work on the construction of the Springfield, Wilmington & Cincinnati traction line will commence early in the spring. Material and cars for the new line have been ordered and the company has sold bonds to the amount of $4,000,000. It is announced that the main power house will be located at Clarksville, near Wilmington, and seven sub-stations will be installed along the line. The road has been incorporated as the Springfield, Wilmington & Cincinnati Railway Company, with a capital stock of $4,000,000.

TOLEDO, OHIO.—Preliminary steps have been taken by the Toledo, Port Clinton & Lakeside Railway Company toward the building of a spur line from Port Clinton to the Ohio rifle range, a distance of about five miles.

TOLEDO, OHIO.—The Board of Education has awarded the Toledo Railway & Light Company the contract for lighting the public school buildings for a term of three years. The price submitted for electricity for lighting was four cents per kw-hour and for power three cents per kw-hour.

TOLEDO, OHIO.—The Fisher Electric Company of this city has changed its name to the Toledo Electric Company.

WOODSFIELD, OHIO.—The Woodsfield Telephone Company has increased its capital stock from $25,000 to $50,000.

EUGENE, ORE.—William T. Campbell has taken out a water right, appropriating 88,000 miner's inches of water, for generating electrical energy and other purposes. The company will be known as the Kelsey Electric Power Company.

EUGENE, ORE.—The Willamette Valley Company has taken out a water right on the McKenzie River near Vida, which will use 80,000 miner's inches, and it proposes to use the power thus developed in carrying on an electric line from Eugene to Blue River. It is said that work on the power plant and the road will begin early in the spring.

HAINES, ORE.—The electric plant of the Radium Electric Company has been completed and is now furnishing electricity for lighting the town of Haines. Goodwin A. Young is president and general manager.

OREGON CITY, ORE.—Joseph M. Healy, of Oregon City, has filed at Albany, Ore., plans and specifications of the Santiam Electric Company for the construction of seven power canals along North Santiam River, developing an immense power.

ST. HELEN, ORE.—C. E. Hollopeter, of the Edwin C. Amme Company, of Portland, is considering the question of making application for permission to furnish electric light and power for St. Helen and Houlton.

PITTSBURG, PA.—The Pittsburg Railways Company has secured rights of way from Glassport to Elizabeth for an electric railway to be built this summer. From there the line will be extended to Charleroi.

PAWTUCKET, R. I.—A bill has been introduced in the Rhode

Island Legislature authorizing the Pawtucket Electric Company to issue $2,000,000 bonds to refund the present bonded debt, pay floating debt and to provide for extension.

ABERDEEN, S. D.—F. W. Raymond, city auditor, writes that it is proposed to construct an electric light plant to cost $35,000. Chas. L. Pillsbury, of Minneapolis, Minn., is engineer.

ABERDEEN, S. D.—Claussen, Burch & Pillsbury, of St. Paul, Minn., are consulting engineers for the city lighting plant.

MEMPHIS, TENN.—At a recent meeting of the executive officers of the Memphis Telephone Company it was decided to issue at once securities to the value of $800,000 for the purpose of enlarging its plant and expanding its business. It is the intention of the company to double the present capacity of its plant and to reach out for long distance business. Harvey Myers is president.

NASHVILLE, TENN.—A bill authorizing the city of Nashville to issue $300,000 in bonds to enlarge the municipal electric light plant so as to do commercial lighting has been introduced in the State Legislature.

DENISON, TEX.—The directors of the Denison Light & Power Company have decided to make improvements to its plant, at a cost of about $50,000. W. B. Munson is president.

MANCHESTER, VA.—The arrangement under which the city is being furnished 70 arc lamps free of charge by the Virginia Passenger & Power Company will soon expire, and the question of constructing a municipal electric lighting plant is being strongly agitated at present. It is understood that the city will erect a plant and purchase the poles and lighting system of the Virginia Passenger & Power Company. Engines at the new filter plant being erected by the city will supply the necessary power plant for the electric plant, which will be operated in conjunction with the city water works plant.

PORT ANGELES, WASH.—An election will be held Feb. 15 to vote on the question of issuing $80,000 in bonds for the purpose of establishing a municipal electric light and water plant. A plant of 350 hp is under consideration.

BEAVER DAM, WIS.—The City Council has directed the Wisconsin Telephone Company to place its wires underground in the business district of the city.

EAU CLAIRE, WIS.—Mayor Frawley has appointed a committee to investigate the question of building a dam at the lower end of city limits at Chippewa River, to be used to provide power, etc.

HATFIELD, WIS.—W. J. Ferris, of La Crosse, general manager La Crosse Water Power Company, writes that the proposed dam to be constructed on Black River at Hatfield will cost about $1,000,000. Bids will be called for soon.

MENASHA, WIS.—The question of establishing a municipal lighting plant is under consideration.

MENOMINEE, WIS.—The City Council has granted the various franchises applied for by the Chippewa Valley Electric Railway Company in this city. The company is to build an electric railway between Eau Claire and Menomonie.

MERRILL, WIS.—The stockholders of the Merrill Telephone Company are considering the installation of the automatic telephone system in this city.

OSHKOSH, WIS.—C. O. Frank and J. A. Powers, of Oshkosh, are interested in the construction of a power plant on Peshtigo River, at Johnson Falls, Wis.

PORTAGE, WIS.—Prof. Dugald C. Jackson, of the University of Wisconsin, Madison, is preparing plans for the construction of a cement plant for the Wisconsin Portland Cement Company, to be erected near Portage. The plant will be operated by electricity transmitted from the power plant on the Wisconsin River at Kilbourne.

SUPERIOR, WIS.—Bids will be received by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until Feb. 25, for the installation of a conduit and wiring system in the U. S. Post Office at Superior.

UNION GROVE, WIS.—The Union Grove Telephone Company has increased its capital stock from $5,000 to $15,000.

WEST ALLIS, WIS.—A movement is on foot for the establishment of a municipal electric light plant here.

FORT WILLIAMS, ONT.—The Kaministikwia Power Company is preparing to double the capacity of its hydro-electric power plant at Kakabeka Falls, near Fort William. Work will be begun as early as possible this spring. W. A. Black is managing director of the company. The present capacity of the plant is 10,000 hp.

LONDON, ONT.—The telephone exchange in this city was recently destroyed by fire, causing a loss of $10,000.

PETERBOROUGH, ONT., CAN.—The Canadian General Electric Company has decided to build new shops, giving an additional 75,000 square feet of floor space.

TORONTO, ONT.—The Toronto Electric Light Company will apply to the Ontario Government for permission to increase its capital stock by $1,000,000, making the total capitalization $4,000,000. The company states that the proceeds are to be used to make additions to the plant necessary for the handling of the Niagara power now being used by the company.

Company Elections.

NEW HAVEN, CONN.—At the annual meeting of the Southern New England Telephone Company, held Jan. 29, President Morris F. Tyler was re-elected and James S. Hemingway, vice-president, was also re-elected. The office of secretary, held by Victor M. Tyler, who recently resigned, was merged with the office of treasurer, and General A. H. Embler, treasurer for 25 years, will have the office of secretary and treasurer.

WASHINGTON, D. C.—At the annual meeting of the Washington Railway & Electric and the Potomac Electric Power Companies, held Jan. 19, all of the present officers and the boards of directors were re-elected.

GLENS FALLS, N. Y.—At the annual meeting of the Hudson River Power Transmission Company, held Jan. 21, the following officers were elected: Eugene L. Ashley, president; W. H. Trumbull, of Boston, Mass., vice-president; Elmer J. West, secretary and treasurer.

READING, PA.—At the annual meeting of the Berks County Light, Heat & Power Company, held recently, the following officers were elected: Samuel D. Dibert, president; J. Bennett Nolan, secretary and treasurer; directors: Jeremiah Mohn, Samuel D. Dibert, Jacob S. Hillegass and J. Bennett Nolan.

New Industrial Companies.

THE BRYAN INSULATING FIBRE COMPANY, of Bryan, Ohio, has been incorporated with a capital stock of $25,000. The directors are: H. J. Myers, E. A. Wolff, E. B. Willett, J. H. Reid and A. F. Young. H. J. Myers was chosen president E. B. Willett, vice-president; E. A. Wolff, secretary and treasurer, and A. F. Young, general manager. The company will manufacture telephone receivers, mouth pieces and transmitters from wood fibre, made under a secret process, the invention of Howard J. Myers.

THE C. & D. COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture motors. The directors are Dana T. Ackerly, H. W. Smith and F. C. Heuser, of New York.

THE CHICAGO LIGHT & EQUIPMENT COMPANY has been incorporated at Camden, N. J., with a capital stock of $5,000,000, by Garfield Scott, M. Joseph Pickering and William B. Macdonald. The company will manufacture lamps, fixtures, chandeliers, etc.

DUFFY LOCOMOTIVE & STATIONARY STOKER COMPANY, of Trenton, N. J., has been incorporated with a capital stock of $125,000 by E. L. Kern, J. K. Neagley and N. F. Bucking. The company will do mechanical and electrical engineering work.

THE ECK DYNAMO & MOTOR WORKS, of Belleville, N. J., has been incorporated with a capital stock of $100,000, by W. C. Clark, William L. Rainhard and H. J. Dilg.

THE ELECTRIC FITTINGS COMPANY, of Trumansburg, N. Y., of New York, N. Y., has been incorporated with a capital stock of $125,000, for the purpose of manufacturing electrical machinery and fittings, etc. The incorporators are: William P. Briggs and Edwin P. Bouton, of Trumansburg; Nelson H. Raymond, of Brooklyn.

THE OFFENHEIMER ELECTRIC COMPANY, of Augusta, Me., has been organized for the purpose of manufacturing electrical apparatus. The company has a capital stock of $500,000. J. Berry is president and treasurer.

THE OXIDE BATTERY DEPOTS, of Jersey City, N. J., and Chicago, Ill., have been incorporated, with a capital stock of $30,000, in New Jersey, and $18,000 capital stock in Illinois.

THE PUYALLUP ELECTRIC SUPPLY COMPANY, of Puyallup, Wash., has recently been organized by C. C. Farmer and J. D. Huffman. The office is located at 101 West Main Street, Puyallup.

THE UNIVERSILA ELECTRIC SECURITY COMPANY, of Albany, N. Y., has been incorporated with a capital stock of $4,000. The company proposes to manufacture electrical burglar alarms, etc. The incorporators are: Hessel B. Hackley and H. Mills, of Albany, and George Moosman, of Rensselaer.

THE WILSON ELECTRIC MANUFACTURING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $100,000, by William S. Rosenstrauch, Harry Berger and Robert E. Wilson.

New Incorporations.

GLOBE, ARIZ.—The Globe-Arizona Telephone Company has been incorporated with a capital stock of $100,000 by J. D. Coplen, president, and S. L. School, secretary and treasurer.

GLOBE, ARIZ.—The Globe Electric, Gas & Water Company has been incorporated with a capital of $750,000, by C. N. Bassett, B. A. Nebeker and others. Principal place of business Globe, with offices in Los Angeles, Cal.

NAPA, CAL.—The Napa & Vaca Valley Railroad Company has been chartered to construct a railway (probably electric) between Vallejo

and Vacaville. The company is capitalized at $500,000. D. A. Dunlap, E. H. Winship and H. M. Meacham are interested in the project.

RED BLUFF, CAL.—The Pacific Power Company has been granted a charter by the Secretary of State, with a capital stock of $1,000,000. The company recently purchased the rights and lands of the Mt. Lassen Power Company at a cost of $45,000, and will soon commence work on the construction of a power plant, which will supply electric energy in the Sacramento Valley within eighteen months.

REDDING, CAL.—The Northern Light & Power Company has been organized in Shasta County by A. F. Smith, T. H. Benton and others. The company has a capital stock of $600,000.

SAN DIEGO, CAL.—The Point Loma Electrical Railway Company has filed articles of incorporation with a capital stock of $100,000. The directors are D. C. Collier, George M. Hawley, Samuel F. Smith, George D. Easton and C. O. Reinbald.

SAN FRANCISCO, CAL.—The Farmers' Electric Light & Power Company has filed articles of incorporation with an authorized capital stock of $2,000,000. The company will deal in electricity for lighting and power. The directors are: H. D. Colyar, Olin L. Berry, F. E. Brady, G. W. Miller, C. W. Doble and John Royles.

SAN FRANCISCO, CAL.—The City Electric Company has been incorporated with a capital stock of $5,000,000 to furnish electricity for light and power in the city of San Francisco. Plans have been prepared, machinery ordered and the managers expect to be able to have the plant in operation within six months. The plant will have a capacity of 10,000 hp and crude oil will be used for fuel. Andrew M. Hunt will have charge of the construction of the plant. The directors are: Adolph Mack, J. J. Mack, W. S. Goodfellow, Charles F. Eells, Henry Steinbach, Mortimer Fleischhacker, Herbert Fleischhacker, Walter Arnstein and F. W. Smith.

SAN FRANCISCO, CAL.—The California Rapid Transit Railroad Company has filed incorporation papers at Phoenix, Ariz., to build lines of railroads in different parts of California. The company is capitalized at $10,000,000. The incorporating directors are: William G. Alberger, L. E. Lee and William Minto, all of San Francisco. The temporary officers elected are: William C. Alberger, president and chief engineer; L. E. Lee, secretary; William Minto, vice-president; W. H. H. Hart, treasurer.

SANTA CRUZ, CAL.—Articles of incorporation have been filed for the Pit River Power Company for the purpose of erecting a power plant on Pit River. The incorporators are J. H. Logan, of Brookdale; Joseph T. Sheehan, of San Francisco; H. F. Mahinney and William Jetzer, of Santa Cruz.

GARDEN CITY, COL.—Articles of incorporation have been filed for the Garden City Telephone, Light & Manufacturing Company by F. R. Marsh and others. The capital stock of the company is $150,000.

LYME, CONN.—John H. Woodbury and Joseph S. Huntington, of Old Lyme, and E. Hart Geer, of Lyme, has filed a petition to the State Legislature with the Secretary of State for the incorporation of the Lyme Electric Power Company with authority to do business in Lyme, Old Lyme, East Lyme, East Haddam, Waterford, Essex, Saybrook, Old Saybrook and Haddam.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago & Western Telephone Company, with a capital stock of $100,000. This company will be the local operating company of the independent telephone interests that have acquired control of the telephone rights of the Illinois Tunnel Company. S. S. Gregory is counsel for the company.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago & Western Telephone Company with a capital stock of $100,000 by Conrad Poppenhausen and others.

CHICAGO, ILL.—The Harvard Light & Power Company has filed articles of incorporation with the Secretary of State with a capital stock of $50,000. The incorporators are: H. J. Tauer, Robert F. Kolb and George L. Turnbull.

DECATUR, ILL.—A charter has been granted to the Decatur, Taylorville & Litchfield Traction Company, with a capital stock of $5,000. The incorporators are Dudley Taylor, Frederick W. Job and others. The principal office will be in Chicago.

PARIS, ILL.—The Terre Haute & Western Railway Company has been incorporated with a capital stock of $100,000 by the Stone & Webster interests. The company proposes to make application for a franchise to operate a street railway on East Court Street in this city. The directors are: John E. Lamb and C. T. Murdock, of Terre Haute, Ind.; William Trogdan, of Vermillion; Frank T. O'Hair and James Stuart, of Paris.

PLEASANT HILL, ILL.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $2,500 by P. D. Roberts, B. A. Galloway and W. S. Freeman.

ROBINSON, ILL.—The Southeastern Illinois Long Distance Telephone & Telegraph Company has been incorporated with a capital stock of $2,500 by W. M. Long, F. W. Lewis and C. R. Harris.

WILMINGTON, ILL.—The Wilmington Light & Power Company has been incorporated with a capital stock of $15,000 by J. H. Ray, A. J. McIntyre and J. C. Thompson.

GARY, IND.—Articles of incorporation have been filed with the Secretary of State for the Gary, Hammond & Eastern Railway Company with a capital stock of $100,000. The directors are: H. F. Walton, P. P. Porter, William Warmsley and Charles Broadecker.

INDIANAPOLIS, IND.—The Chicago, South Bend & Northern Indiana Railway Company has been incorporated with $7,500,000 capital stock. The directors are Charles F. Dieterich, James Murdock, Chas. M. Murdock, A. E. Dieterich, S. T. Murdock, Hugh J. McGowan, W. T. Durbin, R. I. Todd and H. B. Smith. This company has purchased the Northern Indiana Railway system and in addition to expending a million dollars on improvements, will build a line from Michigan City to Chicago.

JEFFERSON, IND.—The Jeffeffrson Telephone Company has been incorporated. Wm. H. Engle, Jno. W. Stafford, D. F. Yeong and B. M. Knapp are the incorporators.

LEESBURG, IND.—The Wilmot Telephone Company has been incorporated with $20,000 capital. The central office will be at Leesburg. Jno. E. Armstrong, W. H. Stanley and J. H. B. Stanley are the directors.

LIGONIER, IND.—The Wawasee, Ligonier, Topeka & Lagrange Railway Company has been chartered with a capital stock of $50,000. The company proposes to sell electricity for light and power to the cities and towns along its lines. The directors are: F. H. Green, F. E. Weir, S. M. Dowell, B. B. Johnson, F. J. Dunton and J. N. Babcock.

SALEM, IND.—The Mill Creek Telephone Company has been incorporated. Louis C. Carter, Wm. P. Cristy and M. L. Stephenson are the directors.

BOSTON, MASS.—The Suffolk Lighting Company has been incorporated with a capital stock of $100,000 by George A. Parmenter, Charles L. Young and Edward H. Taylor.

HAVERHILL, MASS.—The D. T. Kennedy Power Company has been incorporated with a capital stock of $5,000 for the purpose of constructing and operating a power plant. Dennis T. Kennedy is president and treasurer.

DETROIT, MICH.—The Saginaw, Owosso & Lansing Railway Company has been incorporated, with a capital stock of $600,000, by J. L. King, of Syracuse, N. Y.; F. S. Richards, of Cleveland, Ohio; George B. Morley, of Saginaw; Phillip H. McMillan, George Black, Frank W. Eddy, Frank West, Charles W. Baird, Thomas E. Reeder, Charles B. Warren, William B. Cady and J. A. Thick, of Detroit.

OVIATT, MICH.—The Lake Ann & Oviatt Telephone Company has been formed with Mr. Sattler as president; W. W. Wilson, secretary, and T. L. Ball, treasurer.

ELLENDALE, MINN.—Articles of incorporation have been filed for the Ellendale Rural Telephone Company, with a capital stock of $10,000 by W. A. Stanton, W. E. Calloway and E. M. Thompson.

HAMILTON, MO.—The Hamilton Telephone Company has filed articles of incorporation with a capital stock of $30,000. The incorporators are H. S. Cooper and others.

JEFFERSON CITY, MO.—The Central Interurban Traction Company has been granted a charter by the Secretary of State with a capital stock of $50,000. The incorporators are Charles Gutke and others.

OMAHA, NEB.—The Independent Telephone Company, of Omaha, Neb., has filed articles of incorporation with a capital stock of $5,000,000. The incorporators are F. H. Stowe and others.

PATTONSBURG, MO.—The Pattonsburg Home Telephone Company has been incorporated with a capital stock of $25,000 by Elwood Morrison and others.

RENO, NEV.—The Nevada Interurban Street Railway Company has been incorporated with a capital stock of $1,000,000 by Richard Kirman, Louis Gerrum and John N. Evans. The purpose of the company is to construct a street railway to Moana Springs.

CAMDEN, N. J.—The Susquehanna Railway, Light & Power Company has been chartered with a capital stock of $100,000 by William Marriott Canby, Francis C. McCown, Sr., and J. J. Hope.

BATH, N. Y.—The Hornell, Bath & Lake Kauka Railway Company has filed articles of incorporation with a capital stock of $1,000,000. The directors are F. W. Hastings, W. R. Campbell and W. H. Phillips, of Bath.

CALLICOON, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Callicoon Electric Light, Heat & Power Company, with a capital stock of $25,000. The directors are Martin Herman, Peter Herman, and F. S. Anderson, of Callicoon.

CANANDAIGUA, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Canandaigua Southern Electric Railroad Company. The company will operate an electric railway 33½ miles long. The incorporators are E. G. Hayes, Alexander Davidson and others.

ITHACA, N. Y.—Articles of incorporation have been filed for the Ithaca-Seneca Falls Electric Interurban Railway Company with the Secretary of State with a capital stock of $1,000,000, of which $100,000 is to be raised by local subscription. Jacob Rothschild, Ithaca, is president; C. S. Hood, of Seneca Falls, is vice-president; F. M. Bush, of Ithaca, treasurer.

Educational.

IOWA STATE COLLEGE.—Headed by Profs. F. A. Fish and Adolph Shane, a party, consisting of fifteen seniors of the electrical engineering course, have just completed a tour of the principal electrical plants and factories manufacturing electrical apparatus in Chicago and Milwaukee. The trip was timed so as to enable the students to visit the Electrical Show at Chicago. In the same city practical applications of electricity were studied in the plants of the Commonwealth Electric Company, the Western Electric Company, the Kellogg Switchboard and Supply Company, the Automatic Supply Company, and the power plant of the Metropolitan Elevated Railroad Company. In Milwaukee the students were given an insight into up-to-date methods of manufacturing electrical apparatus, spending the better part of a day in the plants of the Allis-Chalmers Company and the Cutler-Hammer Manufacturing Company. In addition to the professors named above, the party consisted of the following members of the senior class: F. A. Skelly, H. L. Walters, J. A. Moorehead, Paul Whallon, G. T. Grove, E. A. Cameron, L. J. Hicks, L. E. Trotter, H. C. Semmons, R. S. Wallis, F. L. Tunis, W. A. Suaveley, C. J. Stahl and H. H. Henningson.

Legal.

EJECTMENT OF TELEPHONE COMPANY FROM INDIAN RESERVATION.—The amendment of 1902 to section 89 of the Indian Law of the State of New York provides that any company may erect poles, wires and other necessary fixtures across the lands of the Seneca Indians on the Tonawanda reservation, and that the company shall pay damages therefor to be determined, in case of inability of the parties to agree upon the amount, in accordance with the provisions of the condemnation law. The Bell Telephone Company of Buffalo in erecting its line across the lands of Wallace Jemison, a chief of the Tonawanda band of Seneca Indians, instead of following this statutory mode of procedure, made application to the council of the Tonawanda Indians and secured a permit upon the payment of $30. In an action by Jemison to eject the telephone company from his lands it was held that the permit was worthless and that he was entitled to the possession of his property. The company interposed the defense that the amendment was unconstitutional for the reason that it conflicted with the statutes of the United States providing for the regulation of commerce with the Indian tribes. The amendment was declared constitutional as the State of New York exercises exclusive sovereignty and jurisdiction over the Seneca Nation of Indians, no federal question, therefore, being involved. The plaintiff, however, failed to prove any damages, and the verdict, though in his favor, was for the sum of six cents only. Jemison vs. Bell Telephone Company of Buffalo, Court of Appeals of New York, 79 N. E. Rep. 728.

TELEPHONE NUMBER NOT A TRADE MARK.—UNFAIR COMPETITION IN SELECTION OF NUMBER.—A telephone company, operating in Salt Lake City, Utah, known as the Rocky Mountain Bell Telephone Company, having established a "trouble department," and having adopted the number 888 for the number of the telephone installed in that department, brought an action against the Utah Independent Telephone Company which had its system in the same city to restrain the latter company from using the number 888 as the telephone call of its trouble department. It was claimed by the Rocky Mountain Company that the telephones of the two companies being similar in construction and appearance, their patrons frequently called up the trouble department of the Utah Company by mistake when intending to notify the Rocky Mountain Company of some defect in the telephone service. In this manner the Utah Company obtained information not intended for it concerning the telephones of the Rocky Mountain which needed to be put in order. This information, it was claimed, was followed up by the Utah Company and solicitors were sent to the parties whose telephones were out of repair for the purpose of securing them as subscribers. It was held that, in taking 888 as the number of its trouble department telephone, the Utah Company was not guilty of what in law is termed unfair competition or unfair trade. Unfair competition consists in one person imitating by some device or designation the wares made and sold by another for the purpose of palming off or substituting his wares for those of the other, and in that way misleading the purchaser by inducing him to buy the wares made and sold by the first instead of those by the second. This, in law, constitutes misrepresentation and deception and is a fraud not only against the person whose wares are imitated, but against the public as well. It was further held that the number 888, as used by the Rocky Mountain Company, did not constitute a trade mark which the court would protect from infringement. Both companies had a natural and a legal right to name their departments according to their pleasure, likewise to select such numbers for the telephones connecting with such departments as they desired. The court concluded that while the Utah Company might not, in all things, have conformed to the "Golden Rule," it had violated no legal or equitable rule and could not be restrained from using the telephone number 888. Quoting from the opinion, "Modern business seems not to be conducted strictly in accordance with the moral code, and if we assumed the authority to issue an injunction every time we thought this code was being violated, it would not be long before there would be no business transacted, except court business." Rocky Mountain Bell Telephone Company vs. Utah Independent Telephone Company, Supreme Court of Utah, 88 Pac. Rep. 26.

LIABILITY OF RAILROAD COMPANY FOR DESTRUCTION OF TELEPHONE LINE BY INDEPENDENT CONTRACTOR.—A railroad company employed an independent contractor to do the construction work upon its line of railway. The roadbed was constructed largely upon ground occupied by the telephone line of the Batesville & Winerva Telephone Company, and in the course of the work the independent contractor removed some 560 of the telephone company's poles with the wires which were strung upon them. The railroad company, before commencing the work of construction, failed to file a map and profile as required by statute and had, therefore, gained no legal right to the land on which the telephone line was located. The defense of the railroad company in an action for damages brought by the telephone company was that the damage was done by an independent contractor, over whom the former had no control, and that the railroad company was, for that reason, absolved from liability. In general it is true that where one has work done by an independent contractor, over whom he exercises no authority, the person contracting for the work is not responsible for the negligence of the independent contractor or his servants. But the rule has certain qualifications, and where the work to be done cannot be accomplished without necessarily doing damage, the person causing it to be done is as much liable for the injuries suffered by the third persons as if he had done the act complained of personally. The railroad company was held responsible. White River Railway Company vs. Batesville & Winerva Telephone Company, Supreme Court of Arkansas, 98 S. W. Rep. 721.

NEGLIGENCE.—CARE REQUIRED OF PERSONS ENGAGED IN TRANSMISSION OF ELECTRICITY.—An illustration of the degree of diligence which is required of one engaged in a business involving the generation and transmission of electricity is found in the case of Colorado Springs Electric Company vs. Soper. A barbed wire which had been stretched along the tops of the poles used by the company had broken so that the loose end rested upon the other wires of the company and hung down near the edge of the roadway, where thirty feet or more of wire lay coiled up. The plaintiff, a boy five years of age, had been allowed by his mother to go out of doors to play with other children. While thus amusing himself he happened upon the company's electrified barbed wire and was seriously injured as a result of the contact. As is usual in such cases the testimony of the expert medical witnesses was not without conflict. Those called by the plaintiff found that his condition was serious, that the term of its continuance was indeterminable and that it was the result of the injury occasioned by the accident. The company's witnesses stated that the plaintiff's condition was temporary and not serious and that it was owing to some cause other than the shock. The verdict, however, was in favor of the plaintiff and was for the sum of $4,500. The parents of the plaintiff were held free from contributory negligence in permitting the child to be out at play in the day time unattended. It was shown that for four months prior to the injury the company's wires had been in the dangerous condition to which the accident was due and the decision was placed upon the ground that the company had failed to exhibit that degree of skill and caution in the maintainance and inspection of its entire plant which was consistent with a proper conduct of its business according to the best known methods prior to the accident and which is by law due from one engaged in a business such as the company was conducting. Colorado Springs Electric Company vs. Soper, Supreme Court of Colorado, 88 Pac. Rep. 161.

ASSUMPTION OF RISK BY EMPLOYE.—DUTY OF MASTER TO PROVIDE SAFE PLACE OF WORK FOR SERVANT.—A pipefitter, in the employ of an electric company, was requested by the line foreman having charge of repairing the wires of the company, to assist him in repairing a wire, which was then a dead wire, and which transmitted electricity from the generators to the trolley lines. While the pipe-fitter was holding the ends of the broken wire, in compliance with the directions of the foreman, an electric current of about 500 volts was suddenly and without notice turned on. He was instantly rendered unconscious and died a few moments later. There was evidence that the place in which the work was being done was damp and that the current had passed through his body and was the cause of his death. In an action against the company brought by the wife of the deceased pipe-fitter she was allowed to recover $14,000 by way of damages. The deceased had not assumed any risk in connection with that work of repairing the broken wire. The foreman, in directing the pipe-fitter to help him, was representing and standing in the place of the master and was not acting in the capacity of a fellow servant. The general rule is that where the master orders the servant into an employment outside the scope of the duties which the servant has contracted to perform, which employment is attended by dangers unknown to the servant and not open to his observation, giving him no warning concerning such dangers, and he is subsequently injured, he is not deemed to have accepted the risk of the dangers to which he is unknowingly exposed. But to bring himself within this rule, the servant must be acting upon the order or request of the master or someone who has the master's authority to act. The electric company, in this instance, had not lived up to the absolute duty imposed upon it by law to provide its servants with a reasonably safe place in which to work and with reasonably safe appliances. Electricity, stated the court, is an "invisible, impalpable force, highly dangerous to life and property," and those who distribute it are bound to exercise care in proportion to the danger involved. Jacksonville Electric Company vs. Sloan, Supreme Court of Florida, 42 So. Rep. 516.

TELEPHONE LINE IS AN ADDITIONAL BURDEN UPON THE HIGHWAY.—The courts of Illinois hold that a telephone line in a public highway is an additional burden upon the fee, for which the owner of the fee is entitled to compensation. Where a telephone company places its line along a highway without first obtaining a grant from the owner of the fee or acquiring a right by eminent domain, the owner is entitled to an injunction compelling the company to remove its poles from the highway and restraining it from further trespasses. The maintenance and user of the telephone line, and the addition of new crossarms, wires and insulators, constitute a continuing trespass, which a court of equity has jurisdiction to prevent by injunction. The fact that a large number of long distance messages are sent over the line daily and that the public derives great benefit therefrom will not help the company in an action to restrain the trespass. The granting of an injunction, however, does not prevent the company from thereafter obtaining a grant or from condemning the property for its use. Burrall vs. American Telephone & Telegraph Company, Supreme Court of Illinois, 79 N. E. Rep. 705.

RIGHT OF STREET RAILWAY COMPANY TO MAINTAIN WIRES AND POLES IN STREETS OF CITY UNDER STATUTE.—In an action to compel a street railway company to remove its wires and poles from one of the streets of Taunton, Mass., it was contended that the company had no right to maintain the same in a street in which it did not operate a line of cars. The statute, which granted the company the right of operating a street railway, provided that the company might "erect and maintain poles, trolley, feed and stay wires and other devices for conducting electricity in, over and under any streets, highways, bridges and townways in any of the cities and towns wherein it has been or may hereafter be authorized" to operate its railway. The plaintiff claimed that the word "wherein" used in the statute related to "streets, highways," etc., and that, therefore, the only streets in which poles and wires might be erected were those in which the company was authorized to run its railway. It was held that "wherein" related to "in any of the cities and towns," the general rule being that a limiting or qualifying word must be confined to the last antecedent, unless the subject-matter requires a different construction, and that the statute authorized the company to erect poles and wires in any street in a city where it had the right to operate a railway regardless of whether cars were run through such street. Williams vs. Old Colony Street Railway Company, Supreme Judicial Court of Massachusetts.

Obituary.

MR. GEORGE A. BOWDEN, proprietor of the Youngstown Gas & Electric Fixture Company, Youngstown, Ohio, died at his home on Feb. 2, at the age of 57 years. He was born in New York and came to Youngstown two years ago.

MRS. B. J. ARNOLD.—We note with deep regret the death of Mrs. Stella B. Arnold, wife of Mr. Bion J. Arnold, the consulting electrical engineer. Her health had been failing for some time, and when tuberculosis developed a few years ago she took up her residence at Colorado Springs, where she died. Before her marriage in 1886, Mrs. Arnold was Miss Berry, of Lansing, Mich. Besides her husband, she is survived by three children. Mr. Arnold was engaged in Chicago on the rehabilitation of the traction system when the news came of his wife's failing condition, and he proceeded at once to Colorado.

MR. H. C. SERGEANT.—This well-known inventor, of rock drill and air compressor fame, died of paralysis last week at Westfield, N. J. He was born in Ohio in 1835. His inventive genius developed early. Most of his time was given to developing labor-saving machinery. Among some of Mr. Sergeant's valuable inventions were the Sergeant valve, the tappet rock drill, the release rotation for drills, and the piston inlet valve for air compressors. He also revolutionized machinery for stone channeling and coal undercutting. He invented the familiar chopping boxes on the elevated and Subway and the various ferry houses. When the Ingersoll-Sergeant Drill Company and the Rand Drill Company consolidated as the Ingersoll-Rand Company Mr. Sergeant retained his interests, but he suffered so from rheumatism that he ceased all activity. He leaves a widow, three daughters, a son and a brother.

Personal.

MR. O. BAERWINKEL, of the Excello Arc Lamp Company, New York City, returned on February 5 from an extended European trip.

MR. C. H. PIERCE, until recently president of the Northampton Electric Lighting Company, Northampton, Mass., has been elected trustee of the Massachusetts Lighting Companies, of Boston, Mass.

MR. E. B. KATTE, chief of electric traction of the New York Central & Hudson River Railway Company, was married Jan. 26, at Irvington, N. Y., to Miss King.

MR. V. C. GILPIN, 120 Liberty Street, New York City, has been appointed Eastern sales agent for the Sterling Electric Company for its flexible steel conduit and armored conductor.

MR. JOHN E. ZIMMERMAN, formerly secretary of the American Pulley Company, of Philadelphia, has become a partner in the engineering firm of Dodge & Day, Drexel Building, Philadelphia.

MR. H. WILMER, formerly superintendent of the Hebron Light, Power & Heating Company, of Hebron, Neb., has recently become superintendent of the Nebraska City Water & Light Company.

MR. T. A. EDISON.—A report was given wide circulation last week that Mr. Edison was dangerously ill at Atlantic City, with a paralytic stroke. At that moment he was hard at work in Orange as usual, but the report brought many anxious inquiries.

PARADIS & THOROLD.—At the last convention of the Union of Municipalities of Alberta, Canada, held at Red Deer, Alberta, Messrs. Paradis & Thorold, Calgary, Alb., were appointed consulting engineers to the municipalities belonging to the Union.

MR. HENRY DOCKER JACKSON has removed his office from 4 State Street to the Broad Exchange Building, 88 Broad Street, Boston, Mass., where he will carry on his business of consulting electrical engineer. He will make a specialty of reports on electrolysis, power distribution for mills, railways and lighting companies, power plant economy and on proposed or existing plants for financial houses.

LT. COL. S. REBER, of the War College, Washington, has been assigned to important Signal Service duty in the Philippines, and will proceed to that dependency early in March. He will be greatly missed in electrical circles, his interest in the American Institute of Electrical Engineers as vice-president, etc., having been unusually strong, and his work for that body has been useful and efficient to a high degree. He takes with him the good wishes of a host of friends and admirers in the profession.

MR. H. A. CURRIE has been appointed assistant electric engineer of the New York Central & Hudson River Railroad Company, to succeed Mr. J. D. Keiley, who was appointed electrical engineer of the company last November. Mr. Currie has been associated with the electrical department of the New York Central Railroad since 1903, when the plans of the company for electrification were first undertaken. He has had a long electric railway experience, having been connected with the Brooklyn Rapid Transit Company for the nine years between 1894 and 1903. In Brooklyn he was engaged in power station work for six years and later he was appointed as assistant to Mr. Keiley, who had charge of the engineering work in connection with the rolling stock of the surface and elevated divisions of the company.

MR. T. AHEARN is the subject of an illustrated biographical sketch in the Ottawa Saturday evening "Citizen" of Jan. 19. This gentleman, who was one of the best known telegraphers in the Dominion, where he was born, was also early interested in the Bell telephone system and then organized the business partnership of Ahearn & Soper, which has been one of the most active and well known pioneers in the development of lighting and traction enterprises in Canada from the Atlantic to the Pacific. In 1890 the two partners took up the development of electric traction in Ottawa and since then they have built up a splendid street railway system, which also has annexed the light and power branches of the business. The company is one of the best managed on this continent. Mr. Ahearn is president of the Ottawa Gas Company, the Consolidated Light, Heat & Power Company, the Ottawa Car Works, the Ottawa Electric Company, and the Ottawa Electric Railway Company. He is vice-president of Ahearn & Soper Limited and the Ottawa Investment Company. He is also a director of the Ottawa Land Association, the Canadian Westinghouse Company, the Ottawa Building Company, the Wallace Realty Company and other enterprises. Mr. Ahearn and his family are persistent globe trotters, and his vacations are spent in circling the world, friends receiving letters and postal cards and other reminders from him from the most out-of-the-way corners.

MR. C. T. ALDEN has been placed in charge of the recently organized electrical department of W. S. Barstow & Company, New York and Portland, Ore. He was formerly with the American Locomotive Company, Schenectady, as chief electrician, and electrical engineer, then with the General Electric Company, and subsequently with the Bath Iron Works, Bath, Me., as engineer in charge of the electrical work of the U. S. S. "Georgia," and the scout cruiser "Chester." On the completion of this work in November, 1906, Mr. Alden assumed his present duties. Mr. M. O. Jenkins, assistant electrical engineer of this department, has had much experience at Schenectady and elsewhere in switchboard engineering and turbine work, as well as in general electric repairing and construction. Mr. J. P. Read, who is also on the staff of this department, is a E. E. of Columbia University. Since his graduation from Rutgers College in 1901, Mr. Read has been in the employ of the New York and Long Island Railroad Company, Crocker-Wheeler Co., Helena Power Transmission Co., Butte, Mont.; Westinghouse and other companies. The electrical construction foreman of this department is Mr. R. R. Pomeroy. In 1901 Mr. Pomeroy was stationed at Fort Wadsworth as assistant electrician until 1903, when he was sent to Fort McKinley. He was subsequently with the Brooklyn Edison Company, and with the Interborough Rapid Transit Company, and later with the New York Central in charge of various electrical work.

News of the Trade.

MANHOLE JUNCTION BOXES.—In order to render manholes of duct systems accessible during flooding or when a cable burn-out is in progress, the General Electric Company, Schenectady, N. Y., has developed a special line of manhole junction boxes.

STEEL MILL MOTORS.—The Crocker-Wheeler Company, Ampere, N. J., reports a large demand for its new form W motor, designed specially for steel mills, showing that it fills a long felt want, and meets the exacting requirements of the steel industry.

FREQUENCY INDICATORS.—As sole United States sales agents for Hartmann & Braun, Machado & Roller, 203 Broadway, New York, have issued an illustrated bulletin dealing with resonance apparatus for the measurment of frequency, speed, etc. The operation of the devices depends upon the fact that a strip of steel fastened at one end and free at the other has a natural vibration period, and may readily be set into vibration when the frequency of the added impulses coincides with its period. In the case of the present apparatus the impulses are obtained from appropriately located electro-magnets arranged along a row of steel strips each attuned to a frequency differing from its neighbor by a uniform amount. It is stated that throughout its whole range the feeds are adjusted to within .2 of an alternation of absolute accuracy.

LINK BELT OFFICES.—By locating a branch office at 321 Ellicott Square Building, Buffalo, N. Y., the Link-Belt Company, of Philadelphia, Chicago and Indianapolis, is in a better position to give personal attention to customers of its drive chain department in Buffalo and neighboring territory of New York, Pennsylvania and Ohio. The facilities of the company in the manufacture of the "Renold" silent and other forms of power-transmission chains are tendered through its representative, Mr. H. C. Minier. No. 440 New York Block, Seattle, Wash., Mr. E. G. Brabrook in charge, is another new branch office of the Link-Belt Company. Increasing business from the far east, Washington, Oregon and surrounding terrtory, in the conveying-machinery manufactured by the company, made personal representation on the Pacific Coast desirable. Seattle was selected as the most advantageous location.

Trade Publications.

THE NATIONAL CARBON COMPANY, following its usual custom, is sending out a calendar which is very artistically and attractively gotten up.

STEAM ENGINES.—Bulletin No. 134 of the Atlas Engine Works, Indianapolis, Ind., gives numerous illustrations and specifications of engines and boilers.

CLUSTERS.—Wireless clusters and lighting specialties are briefly described and adequately illustrated in catalogue B-17A of the Benjamin Electric Manufacturing Company, Chicago.

ICE MACHINERY.—An elaborately prepared catalogue dealing with ice and refrigeration machinery has recently been issued by the Gillette Ice Machine Company, 346 Broadway, New York.

INDUCTION MOTORS.—Much information concerning the constructive details of polyphase induction motors is contained in bulletin No. 1040 of the Allis-Chalmers Company, Milwaukee, Wis.

LIGHTNING ARRESTERS.—The Minnesota Electric Company, Minneapolis, Minn., has issued an illustrated folder dealing with Chapman lightning arresters for telegraph and telephone lines.

ELECTRIC CRANES.—An illustrated folder recently issued by the Whiting Foundry Equipment Company, Harvey, Ill., gives brief descriptions of electric travelers and other cranes for railway service.

ROTARY CONVERTERS.—Bulletin No. 1045 of the Allis-Chalmers Company, Milwaukee, Wis., treats at great length the mechanical and electrical features of rotary converters for railway and lighting work.

TWIST DRILLS.—Catalogue No. 15 of the Standard Tool Company, Cleveland, Ohio, is a 300-page publication illustrating, describing and giving a price list of twist drills, reamers, taps, chucks, milling cutters and special tools.

GAS PRODUCERS.—A neatly illustrated catalogue, designated as circular No. GP-1 has been issued by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, giving much technical information concerning the operation of the Hughes continuous gas producers.

CONDULETS.—The Crouse-Hinds Company, Syracuse, N. Y., has issued an illustrated booklet giving numerous convincing suggestions concerning appropriate uses for "condulets." The illustrations are so very clear that descriptive matter would be superfluous and none is given.

INSULATION.—In its 1907 edition of the "Insulation Book," the Locke Insulator Manufacturing Company, Victor, N. Y., presents such material and data as has withstood the test of actual service. In addition to listing and illustrating insulators for all voltages, many valuable notes are given on the testing and installing of insulators.

ELECTRICAL INSTRUMENTS.—The Wagner Electric Mfg. Company, St. Louis, Mo., has just issued an attractive booklet describing the principles underlying the operation of the moving-coil, the iron-vane and the permanent-magnet types of measuring instruments. The booklet also contains brief references to the various instruments manufactured by the company.

ASPHALT.—The Standard Asphalt and Rubber Company, 944 First National Bank Building, Chicago, Ill., has issued a loose-leaf catalogue dealing with asphalt and rubber compounds, including insulation which may be poured hot around bare copper wires set in wooden troughs. It is stated that a layer of insulation ⅛ in. in thickness will withstand an e.m.f. of 12,000 volts.

SINGLE-PHASE RAILWAY.—An interesting description of the complete equipment of the Toledo & Chicago interurban Single-Phase Railway is given in Bulletin No. 4479 of the General Electric Company, Schenectady, N. Y. The motors are of the compensated single-phase type wound for 250 volts and 25 cycles. There are four motors per car, each being rated at 75 hp.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 29, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

842,163. COMMUTATION OF CURRENTS IN ARMATURES OF DYNAMOS; Engelbert Arnold, Karlsruhe, Germany, and Jens L. LaCour, Edinburgh, Scotland. App. filed Dec. 16, 1904. Commutator connections and form of armature windings for alternating current generators especially for multiphase currents.

842,178. TELEPHONE TRUNKING SYSTEM; William W. Dean, Chicago, Ill. App. filed Jan. 22, 1903. Diagram of cord circuit connections for trunking exchange system.

842,200. MAGNETO; Herman Hess, Indianapolis, Ind. App. filed June 15, 1906. Mechanical construction for the field frames or pole pieces of a magneto generator especially adapted for automobiles. The pole pieces are organized into a gun metal box which receives the the permanent U-shaped magnets thereon.

842,222. CATENARY SUSPENSION FOR TROLLEY WIRES; George A. Mead, Mansfield, O. App. filed Nov. 23, 1904. The trolley poles have laterally extending arms of irregular section which receive brackets or supports slidable thereon from which the hangers depend to support the trolley wires. The brackets also carry messenger cables which support the trolley wires at points between the poles.

842,241. MECHANICAL EAR FOR TROLLEY WIRES; Thomas E. R. Phillips, London, England. App. filed Aug. 1, 1905. The hanger has a pair of depending jaws with lips which can be forced together by a screw to engage the trolley wire and firmly hold the same.

842,254. PROCESS FOR THE ELECTROLYTIC REFINING OF METALS; Alfred Schwarz, New York, N. Y. App. filed Feb. 6, 1904. The process of depositing a metal from its ore consisting in compressing the concentrates of the ore to be treated into solid masses or cakes and supporting such masses in a framework of an insoluble conductive material and then subjecting said anodes to the action of a current in an electrolytic bath.

842,256. ELECTROLYTIC CELL; George O. Seward and Franz von Kugelgen, Holcombs Rock, Va. App. filed July 17, 1905. A non-conductive partition for an electrolytic cell, comprising a plurality of separated water cooled curtains insulated from one another, and the space between them filled with insulating material.

842,273. PROCESS OF REDUCING COMPOUNDS; Frank J. Tone, Niagara Falls, N. Y. App. filed Dec. 16, 1905. The method of reducing silicon compounds, consisting in forming a fused bath of the compound, together with a reducing agent and a flux, interposing the fused bath as a resistance-conductor between electrodes, and reducing the compound; substantially as described.

842,285. BLOCK SIGNALING SYSTEM FOR RAILWAYS; Adoniram J. Wilson, Westfield, N. J. App. filed Aug. 21, 1906. Relates to block signaling systemh for electric railways. Employs the same source of electric energy as that employed for the propulsion of the trains.

842,300. RAILWAY-SIGNAL; Clyde J. Coleman, New York, N. Y. App. filed March 9, 1903. Relates to the details of a local mechanism for raising and lowering a semaphore arm by a liquid carbonic acid gas contained in a box at the base of the semaphore pole. The valves are opened and closed by relay circuits including track rails.

842,301. INSULATING RING AND BRACKET; Frank B. Cook, Chicago, Ill. App. filed Dec. 28, 1905. Relates to insulating rings or the like such as are used for supporting and carrying electrical conductors. The bracket is made of sheet metal embossed so as to receive an insulating bushing of hard rubber or fiber.

842,306. TELEPHONE SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed May 8, 1901. Diagram of cord circuits for a simple multiple exchange system.

842,315. SINGLE TRACK SIGNALING SYSTEM; Robert J. Hewett, Westfield, N. J. App. filed Aug. 22, 1906. Has an overlap system of signals operated by short circuiting of the track rails by a passing train. Employs polarized relays for securing the overlap feature.

842,342. ELECTRIC CONTROLLER; Harry Sawyer, Muskegon, Mich. App. filed Feb. 5, 1906. A controller having a vertically projecting handle adapted to operate a motor in either direction by movements to either side of its central position; is especially adapted for electric cranes and has the resistance element included in the box of the controller.

842,366. ELECTRIC BLOCK SIGNALING SYSTEM; Adoniram J. Wilson, Westfield, N. J. App. filed Aug. 21, 1906. Among other features employs the same source of electric energy as is utilized for the propulsion of the trains.

842,367. ELECTRIC BLOCK AND BLOCK SECTION SIGNALING SYSTEM; Adoniram J. Wilson, Westfield, N. J. App. filed Aug. 21, 1906. Relates to modifications of the above.

842,377. SIGNALING APPARATUS; George F. Atwood, East Orange, N. J. App. filed Feb. 26, 1906. Telephone set including call bell, transmitter and receiver all within a closed box. The receiver is supported in a tray which closes the telephonic circuit when the weight of the receeiver is removed therefrom.

842,389. BATTERY; Frank A. Decker, Philadelphia, Pa. App. filed Feb. 27, 1904. A battery having a plurality of cells, a closed casing containing said cells, a plurality of apertures in said casing, and a valve which covers said apertures alternately, substantially as specified.

842,391. THERMOPILE; Henry Diecks, Eastport, Me. App. filed Jan. 11, 1906. Patentee provides an electric thermopile in the exhaust pipe of a gas engine for supplying the ignition current.

842,405. SWITCH FOR STORAGE BATTERIES; Seth A. Leonard, Cleveland, O. App. filed May 14, 1906. In switches for storage batteries, a suitable supporting frame, longitudinally-movable plates mounted oppositely on said frame, and brush and plate connections for the current operatively related to said plates.

842,407. EXTRA HIGHLY VIBRATING CONTACT BREAKERS; Gustave Mamy, Paris, France. App. filed Dec. 9, 1903. The core of the induction coil is prolonged by a specially shaped plug of iron which constitutes a pole to attract the vibrator.

842,409. COMBINED ANNUNCIATOR AND JACK FOR TELEPHONE-SWITCHBOARDS; Martin V. Mehren, Genoa, Ill. App. filed June 2, 1904. The combination with an annunciator and drop therefor, of a restoring-lever plug below the drop and pivoted between its ends and arranged to be actuated by the plug on insertion and to act upon the drop to restore the same.

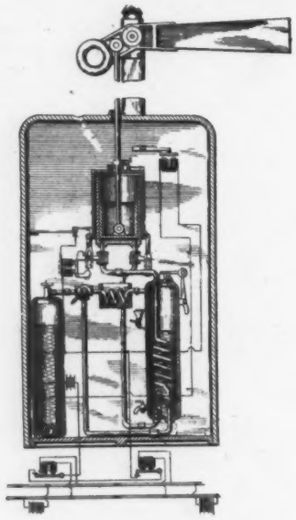
842,410. TELEPHONE-SWITCHBOARD; Martin V. Mehren, Genoa, Ill. App. filed June 2, 1904. In a combined jack and annunciator, the combination of a jack-socket and drop, and a drop-restoring lever made in the form of a ring encircling the jack and pivoted thereto, substantially as described.

842,413. ELECTROMAGNETIC POWER GENERATOR; Reinhold A. Miller, Indianapolis, Ind. App. filed Mar. 14, 1906. A toy motor having a dry battery cell and magnets which intermittently attract levers so as to rotate a crank and wheel.

842,432. ELECTRIC SIGNAL FOR RAILWAYS; Horatio Smelser, Ashton, Neb. App. filed Oct. 7, 1905. Includes the complete details of a semaphore installation in which the signal circuits are completed by mechanical tappets impinged against by the car wheels in passing.

842,445. LETTER BOX; Stephen J. Carleton, Arcadia, Fla. App. filed Aug. 27, 1906. A mail box having a tray or pan therein which closes a circuit so as to raise a signal shutter in case mail is inserted in the box.

842,479. MEANS FOR SUPPORTING RECEPTACLES AND THE LIKE; George A. Litz, New York, N. Y., and Clarence C. Sibley, Perth Amboy, N. J. App. filed Oct. 26, 1905. The porcelain casing



842,300.—Railway Signal.

of the receptacle has a pair of long extensions or legs therefrom which straddle the molding on which the receptacle is received, and may be screwed directly to the ceiling on which the wires run.

842,515. ELECTRIC MOTOR SYSTEM; George Baehr, McKeesport, Pa. App. filed Sept. 17, 1904. Circuits of a controller adapted to operate a four-pole motor at forward and reverse speeds by the motion of a single controller arm.

842,545. ELECTRICAL CONNECTION FOR RAILWAY RAILS; Eugene Hayward, Clayton, Mich. App. filed Aug. 21, 1905. The rails are recessed at their junction so as to receive the bond directly in the plane of the webs of the rails. In this way the bond is wholly covered up and protected by the fish plates.

842,554. ELECTRIC WATER ALARM; Albert Johnson, New York, N. Y. App. filed Mar. 20, 1906. Two floats, one for high and one for low level, depend in the tank from a single chain. The chain is supported by a blade spring which makes one contact when the weight of both floats is imposed thereon and another contact when the weight of neither float is supported. In this way the blade completes high water and low water alarm circuits.

842,565. ANNUNCIATOR; Harry J. Kusel, Chicago, Ill. App. filed Nov. 20, 1905. An annunciator, including a displaceable winding, means for holding the winding in a normal position, and a spring for displacing the winding when said means are operated to permit the displacement of the winding.

842,571. INSULATION FOR COMMUTATORS; Max Meirowsky, Cologne-Ehrenfeld, Germany. App. filed July 13, 1905. Insulation laminæ for commutators consisting of calcined mica.

842,574. ELECTRIC DANGER SIGNAL; Alexander McCahon, St. Joseph, Mo. App. filed Apr. 30, 1906. A railroad signal system having among other features a specially constructed arm projecting from the locomotive which carries five contacts to ride on five trolley wires extending on the under side of an insulating board or support.

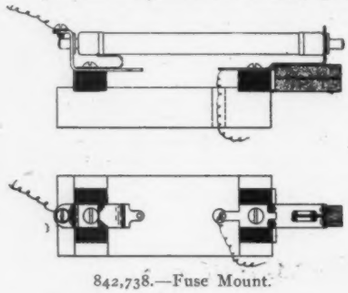
842,583. MAGNETIC SEPARATOR; Charles J. Reed, Philadelphia, Pa. App. filed Aug. 15, 1902. Has a rotating magnet with a specially formed pole piece and a disc of non-magnetic material, all of which operate in an inclined plane corresponding to the path of flow of the ore particles.

842,616. BATTERY JAR OR CELL; Joseph Y. Bradbury, Somerville, Mass. App. filed Oct. 25, 1906. Has a glass jar and flexible fibrous jack which leaves uncovered a portion of the outer surfaces near the tips so that an acid resisting coating may be placed thereon.

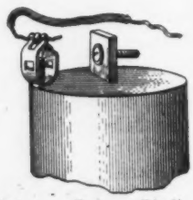
842,619. SYSTEM OF PNEUMATIC CONTROL; Einar J. Bring, Wilkinsburg, Pa. App. filed July 25, 1906. Pneumatic multiple unit control of trains. Has a number of air pipes, some of which are under constant pressure and others of which have their pressure varied for the actuation of the operating pistons.

842,624. COMMUTATOR; Allen F. Carver and James N. Stout, New York, N. Y. App. filed Nov. 25, 1905. Relates to a commutator in which the make and break of the controlling circuit is effected by the separation of the contact points in a line directly toward and away from each other so as to protect terminals and avoid sparking.

842,627. STARTING MEANS FOR INTERNAL COMBUSTION ENGINES; Clyde J. Coleman, Rockaway, N. J. App. filed Sept. 17, 1903. An auxiliary motor is provided in an automobile for starting the engine from the seat. Has a special form of magnetic clutch by which the parts are frictionally geared together when desired.



842,738.—Fuse Mount.



842,771.—Battery Binding Post Attachment.

842,628. SUBSTATION PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed Mar. 12, 1906. Details of an arrangement for supporting and connecting the fuses in a panel board.

842,673. ELECTRICAL APPARATUS FOR SETTING THE POINTS AND SIGNALS ON RAILWAYS; Lorenz Kottmair and Rudolf Zwack, Munich, Germany. App. filed July 3, 1903. Provides for setting the switch points and signals on a railroad by means of electrical devices which act on the switch points and signals in succession so that when an electric circuit belonging to a line is closed each succeeding actuating device after operating closes the circuit of the next.

842,730. METHOD OF MAKING ELECTRICALLY-CONDUCTING BODIES FOR USE AS CONTACTS; Hermann Viertel, Charlottenburg, and Georg Egly, Lichtenberg, near Berlin, Germany. App. filed Sept. 22, 1906. A method of making electrically-conducting bodies for use as contacts consisting in intimately mixing together metallic powders, and carbon, pressing and molding the mixture, and heating the same until softening and alloyage take place.

842,738. FUSE-MOUNT; Charles E. White, Chicago, Ill. App. filed Apr. 19, 1906. Spring clamping means for holding fuse cartridges in place. Has a combination sheet metal support having both rigid and springy blades or leaves which co-operate together.

842,740. TROLLEY; Pearl J. Wires, Osborn, O. App. filed Mar. 13, 1906. A pair of trolley wheels are journaled in yokes on a swivel support so as to continue in alignment with the trolley wire regardless of the direction of the pole.

842,771. BATTERY BINDING-POST ATTACHMENT; George H. Cove, Roxbury, Mass. App. filed Nov. 26, 1906. The terminals of a dry battery are made of spring clips which engage and hold a terminal by their resiliency.

842,772. PARTY-LINE TELEPHONE SYSTEM; William W. Dean, Elyria, O. App. filed Apr. 17, 1905. Details of a signal or call bell adapted to operate only for an alternating current of predetermined frequency.

842,778. TELEPHONE-EXCHANGE; Benjamin O. Fox, Milwaukee, Wis. App. filed Dec. 11, 1905. Switch hook connections for a subscriber's set.

842,781. INSULATING CROSSOVER FOR ELECTRIC RAILWAYS; Edward E. Gilmore, Philadelphia, Pa. App. filed Sept. 27, 1905. Details of construction of the crossover by which one line is kept electrically separated from the other, as is desirable in case of different railroads or different circuit potentials.

842,801. STORAGE BATTERY PLATE; William Morrison, Chicago, Ill. App. filed Jan. 20, 1905. A storage-battery support or grid consisting of a phosphorous alloy containing lead and antimony.

842,815. RAIL JOINT; Edward H. Schwartz, Chicago, Ill. App. filed May 25, 1903. Fish plates are formed with portions which underlie the base of the rail so as to make a tight connection therewith and to press a contact bar into close engagement with the rails to serve as a bond.

842,822. TELEPHONE SYSTEM; Herschel R. Turner, Hoxie, Kan. App. filed May 12, 1906. The combination with two line wires, of a plurality of stations connected in multiple to the line wires and each having a settable and a moving contact, an electromagnet controlling each moving contact, a generator, and means for producing a pulsating current along the line and at each station to act on the electromagnets of all the stations.

842,827. MEANS FOR OPERATING MOTOR VEHICLES; Clyde J. Coleman, New York, N. Y. App. filed Feb. 11, 1901. A motor vehicle starting device including a motor and a storage battery and a centrifugal device for controlling the circuits.

842,829. PROCESS OF MAKING COMMUTATORS; Thomas Duncan, LaFayette, Ind. App. filed Jan. 23, 1905. Process of making commutators for motors which consists in cutting a groove in a metallic bar, inserting a strip of precious metal therein and subdividing the composite body of metals into commutator segments.

842,843. SAFETY ELECTRIC SWITCH; Arthur H. Williamson, Lachine, Quebec, Canada. App. filed Feb. 3, 1906. A knife blade switch wholly enclosed in a box and operable by a sliding panel so as to be entirely safe against fire.